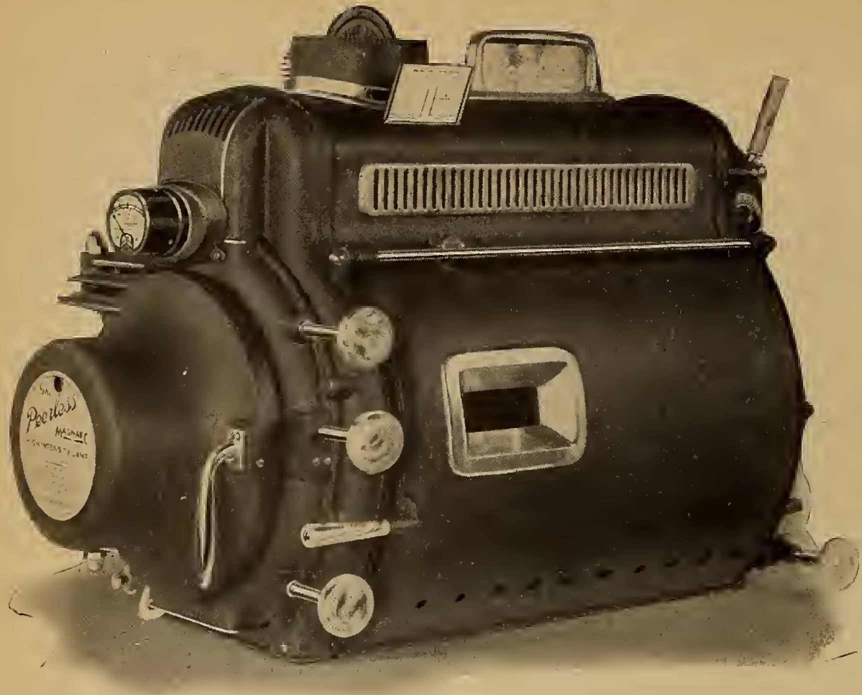
International PROJECTIONIST

JANUARY 1937 Vol. 12, No. 1

25c Copy

$2 a year



THE

1934

1935

1936

LEADERSHIP

OF

Peerless MAGNARC

TRADE MARK REG.

GUARANTEES ITS SUPREMACY FOR

1937

SINCE its introduction, this projector arc lamp has made an enviable record. It was instantly recognized the leader, and has ever since retained this enviable position.

Peerless Magnarc Lamps have been adopted as standard factory equipment by the manufacturers of the world's finest projector, the Simplex; the greatest theatres and theatre circuits.

Today it is the greatest dollar-for-dollar value and the finest projector arc lamp ever built.

THAT IS WHY THERE ARE MORE PEERLESS MAGNARC LAMPS IN USE THAN THE COMBINED TOTAL OF ALL OTHER MAKES

SOLD BY

NATIONAL THEATRE SUPPLY CO.

MANUFACTURED BY

J. E. McAULEY MFG. CO.

552-554 W. ADAMS ST. CHICAGO, ILL., U. S. A.

THE WORLD'S LARGEST PRODUCER OF PROJECTOR ARC LAMPS

International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 12 JANUARY 1937 *Number 1*

Published Monthly by

JAMES J. FINN PUBLISHING CORPORATION

580 FIFTH AVENUE, NEW YORK, N. Y.

Circulation Manager, RUTH ENTRACHT

SUBSCRIPTION REPRESENTATIVES

AUSTRALIA: McGills, 183 Elizabeth St., Melbourne
NEW ZEALAND: Te Aro Book Depot, Ltd., 64 Courtenay Place Wellington
ENGLAND AND DOMINIONS: Wm. Dawson & Sons, Ltd., Pilgrim St., London, E. C. 4.

YEARLY SUBSCRIPTION: United States and possessions, $2 (two years, $3); Canada and foreign countries, $2.50. Single copies, 25 cents. Changes of address should be submitted two weeks in advance of publication date to insure receipt of current issue. Entered as second-class matter February 8, 1932, at the Post Office at New York, N. Y. under the act of March 3, 1879.

INTERNATIONAL PROJECTIONIST is not responsible for personal opinions appearing in signed articles in its columns.

420

MONTHLY CHAT

THE response to our editorial, "Specific Data in all Sound Contracts," which appeared last month, has been most encouraging and is indicative of the growing tendency of projectionists to take a personal interest in the welfare of the theatre plant as a whole. After all, the boss knows little or nothing about the technical niceties of visual or sound projection equipment, which fact makes it possible for the projectionist to extend a lift and gain prestige. I. P. welcomes such inquiries.

PROJECTIONISTS, whether organization members or not, should personally see to it that their employers are observing the provisions of the Social Security Act, payments under which are due now for the month of January. Check this.

ON OUR desk at the moment are three bulky manuscripts which reveal how several workers have "solved" the problem of three-dimensional motion pictures. One of these also throws in a color process, "costing no more than black-and-white prints," for good measure. None of them, incidentally, rates more than casual notice—but all of them insist that stereoscopic pictures are necessary to "save" the industry. We should like to know why.

SERIOUS efforts to supplant perforated sound screens with solid sheets are being made. One such screen has been approved by the major sound companies under "certain circumstances" relating to auditorium characteristics. Most good perforated screens occasion a light loss of about 10%—a figure not impressive enough to warrant replacement by a solid sheet unless ideal house conditions prevail. I. P. will advise on contemplated installations.

FLORIDA projectionists have been going to school—and liking it. So much so that arrangements now are being made for a second group session twice the length of the first. Complete details of this plan, applicable to every state, are given within.

OUR recent article on projection room fires uncovered widespread interest anent "specific details" of particular fires. Unfortunately, such data were not available; but if it had been, it would have covered no more nor no less than the usual triangle: carelessness, defective equipment, or a miserable print. Other "causes" are merely variations upon these three main themes.

INQUIRIES relative to the magnification ratio of various Suprex lamps are in progress by a sub-committee of the S.M.P.E. Projection Practice Committee. Since all the lamp manufacturers have been asked to cooperate in these tests. the results should be conclusive and settle this matter.

INTERNATIONAL PROJECTIONIST

VOLUME XII NUMBER 1

JANUARY 1937

TYPES OF SHUTTERS AND THEIR EFFECT UPON PROJECTION

By *A. C. SCHROEDER*

MEMBER, PROJECTIONIST LOCAL UNION 150, LOS ANGELES, CALIFORNIA

SINCE no one has produced a successful continuous projector, we still use the revolving shutter, which is simple but inefficient. It has been used since "way back when." Although simple, some interesting problems are connected with it. It causes a light loss of 50%, and we have not been able to improve this much. It also causes more or less flicker.

Since it has been moved from before the lens to its present position it has improved one feature: it has reduced the heat on the film. On closer observation, however, this is hardly a virtue, because without the shutter we could cut down the light and heat at the arc about 50% and still retain the same illumination at the screen. In other words, a continuous projector would eliminate the shutter and its attendant losses, and we could use less light [and heat] without any reduction of screen brightness.

Being forced to use this "loser," we should make it as efficient as possible. Years ago there was much interest in cutting the blades down as much as possible; this is not the case now. Additional illumination obtained this way is had at no cost. Of course, it has been paid for, but if it is not used it is just so much loss; and if we put it to work again there is no increase in the light bill.

Effect of Small Blade

There is danger in overdoing this. When the main blade is too small, we get "travel-ghost," which sets in before it can be seen by the eye. Many believe a small amount of "ghost" does no harm because it cannot be seen; but there is no doubt that it spoils the definition, or focus, which is often obtained at great expense, due to the cost of good lenses. Good results should not be jeopardized by too much trimming of the shutter. Either extreme is undesirable.

One condition often overlooked is when the lenses are stopped down, reducing the size of the light beam, thus permitting the use of a narrower blade. The reverse also holds, that is, if stops are removed or lenses are replaced by others having a larger aperture, the shutter blade must be increased in order to properly take care of its important job.

It is the general custom to have the cutting blade large enough so that the film starts moving before the light is completely cut off, and so the shutter allows light to reach the screen before the film comes to a complete stop. This does the definition of the picture no good; but if not carried to extremes, it allows more of the light to be utilized.

Since we start losing light the moment the shutter enters the light beam, and since the film can hardly be moved before the shutter has completely covered the beam, it behooves us to make the interval between the two as short as possible, in order to cut off the light in

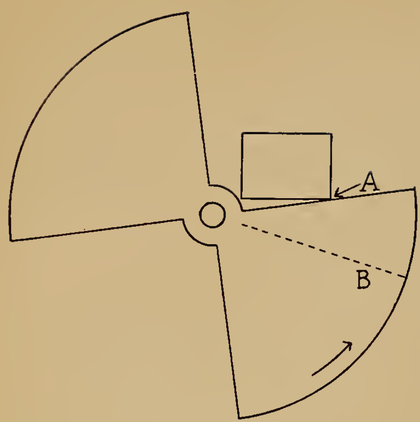


FIGURE 1

the quickest possible time. The same holds true when the shutter clears the light beam. This interval of time depends upon the speed of that part of the shutter which intercepts the light and the distance through which it moves across the beam. This allows the projectionist little leeway, as the matter rests mostly in the hands of the manufacturer.

It is interesting to look back upon the developments of the past and to consider what may be done to effect improvement.

Past Shutter Practice

Those who remember the old Edison, or any machine with an inside shutter, know that the shutter was small compared with shutters used later. It was much smaller than the shutters used before the lens; and those between the arc and the film are monstrous things when we place one of the old Edison types beside it.

The oldest shutter that comes to mind is that on the two-pin Edison. It had only one blade, and I believe it was made of mica. It had a counterweight opposite the blade to balance it and to insure even running. Some inside shutters were larger than the next one on the Edison, which had two blades. The larger inside shutter is represented by Edengraph and Motiograph.

The drawings accompanying this article are not drawn to scale, because some of the machines are not available for inspection and measurement, which in any event would require too much time. However, these drawings illustrate the points under discussion as well as if they were made to scale.

Figure 1 shows the Edison inside shutter just about to enter the light at A. The picture has been framed down all the way, and since the shutter moves up and down during framing, it is shown in the *highest* position. Fig. 2 shows the shutter at its lowest position, when the picture has been framed *up;* and since the shutter has moved away from the aperture during framing, the mechanism has been turned until the shutter is again just entering the light at A.

The dotted line B indicates the leading edge of the blade *when the shutter*

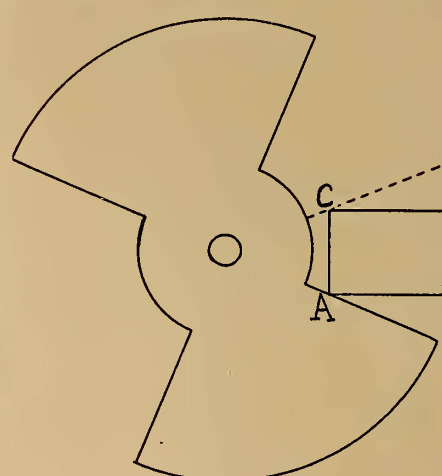


FIGURE 3

was in the same position as in Fig. 1, *before* it was turned to the point where the shutter was about to enter the light, but *after* it had been *framed.* That part of the shutter in Fig. 2 between A and the dotted line B represents the light that is lost when the mechanism is framed to the position in Fig. 1, because the film does not move until the dotted line B in Figure 1 gets to corner A.

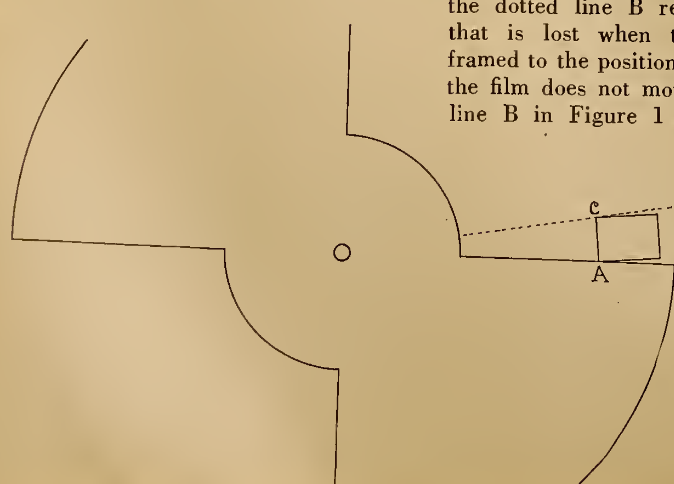


FIGURE 4

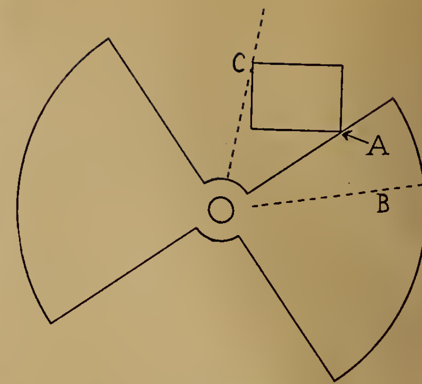


FIGURE 2

Run through this explanation once more and it will become clear.

A similar condition exists when the shutter is leaving the light and the picture is framed at the other extreme. If the framing is at the mid-position, the loss occurs both when entering and when leaving the light, but is only half as much in each instance: thus the total loss from this cause remains practically constant.

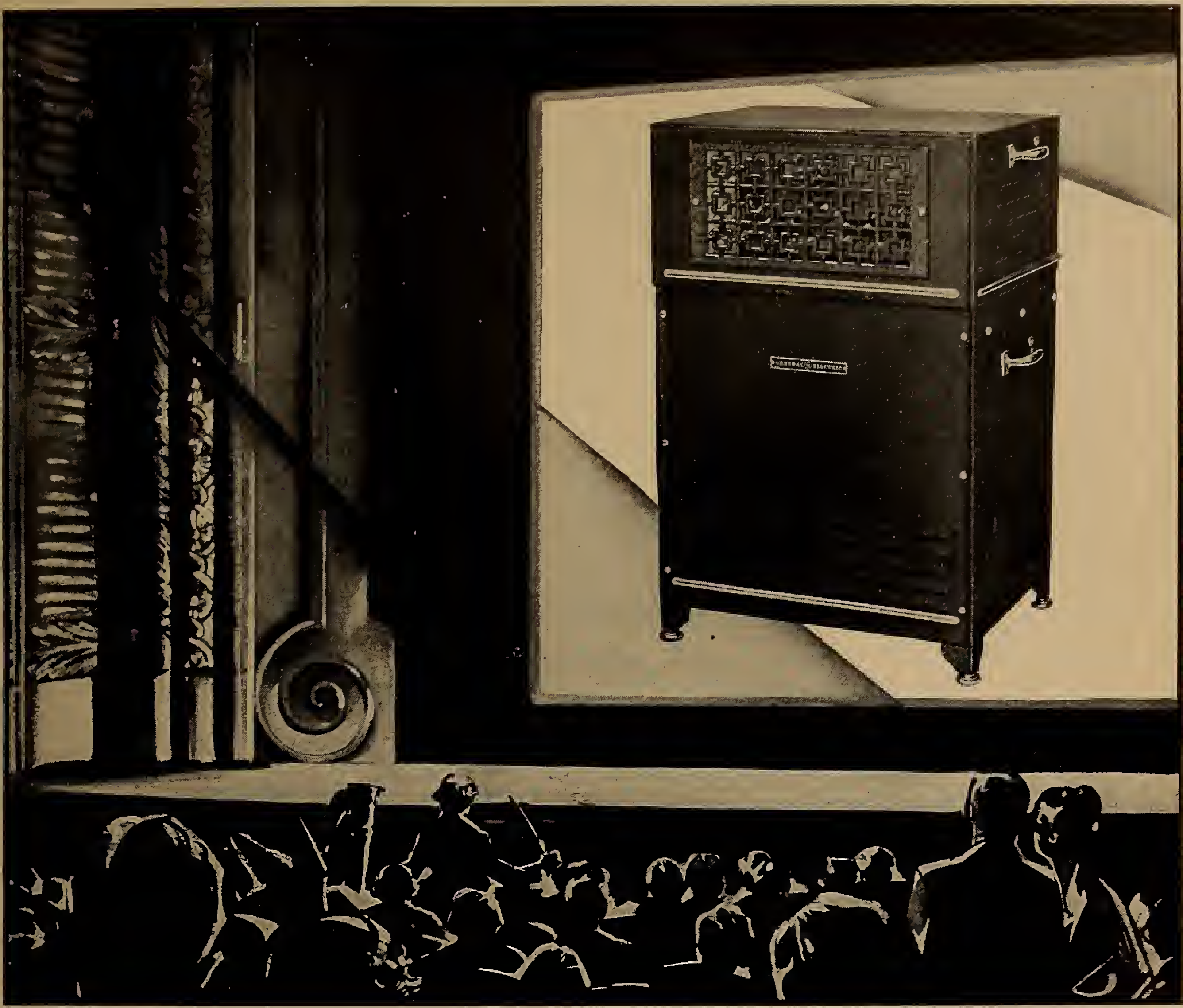
The dotted line C in Fig. 2 indicates the leading edge of the shutter when it has completely cut off the light. A to C, the diagonal across the aperture, is the longest path that can be taken, and one which takes the shutter a greater percentage of one complete revolution to cut off the light than it would if some shorter distance were used.

The shortest distance across the aperture is up and down, and Fig. 3 is so drawn that the shutter travels across the aperture this way. The shutter shaft is level with the center of the aperture hole. This position is not possible with the old Edison, but existed in some other early machines. Here is another drawback, which at first sight might not be evident: the trouble is that the edges of the blade are not parallel to the edges of the aperture hole when they enter and leave the light. The shutter enters the light at A and leaves at C. Notice that the angle between line A and dotted line C is practically the same as the angle between A and B in Fig. 2, so we have gained practically nothing.

Figure 4 shows a larger shutter. The lines A and C are almost parallel to the upper and lower edges of the aperture, and the angle between them is about one-half of that in the previous example, thus causing a complete cutoff of light in about one-half the rotation required before, allowing the blade to be trimmed that much smaller.

Old Motiograph Shutter

A shutter of such dimensions could not be put inside of a picture machine; but Motiograph years ago used a shutter in a small head that was *effectively*



larger than other shutters of that time. This was called the truncated cone shutter, shown in Fig. 5, the view being from the top looking down which is the cross section through the center of the blades. AB represents the aperture, AD and BE the light beam on the way to the lens, and C is the shutter shaft. Although the drawing does not show it, the shutter looks like a truncated cone, that is, a cone which has the point cut off. The distance taken up in a transverse direction across the head is represented by the line F at the lower part of the drawing. Line G shows what the dimensions would have to be if the shutter had been made in the conventional manner and to produce the same results. It allows quite a saving in space.

Figure 6 represents the shutter as viewed from the lamphouse, but with the head having been removed, and the aperture indicated by the dotted oblong CDEF. The aperture hole in these drawings is 11/16 by 15/16 of an inch, which we used in the silent days. The edges of the blade do not diverge at so great an angle. *The edges are not radial* but are more nearly parallel to the edges of the aperture. We also see that this shutter approaches a cylinder, in which case the edges of the blades would be parallel, and is the construction that Motiograph finally adopted in recent years.

The heavy lines A to B are the other blade, and cannot be seen very well because the blade is going in a direction straight away from us, seemingly into the paper. This is part HI in Fig. 5.

Because the edges of the shutter are more nearly parallel to the edges of the aperture hole than they are in the ordinary type shutter, the blade enters the light at D in Fig. 6 at almost the same time that it has entered the light at C, and a similar condition exists at the upper corners. Dotted line H shows the angle of the edge of the Motiograph blade at the moment of entering the light; while *I* shows the angle that would obtain with the ordinary inside shutter having the same effective diameter but taking up more space in the head. Here we have a condition where the distance traveled by the shutter to cut off the light is practically the distance from D to E, which is only a trifle over one-half as far as was the case with the Edison shutter; consequently the blades can be made narrower.

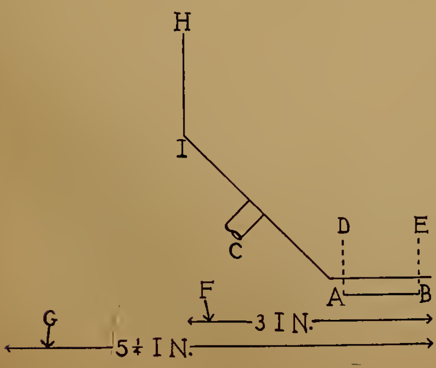


FIGURE 5

Not satisfied with this, Motiograph went a step further and fitted a second shutter of the same type immediately in front of the first one, but revolving in the opposite direction. The first shutter traveled in an upward direction and entered the light at CD. At the same moment the second shutter entered the beam at EF, and was moving in a downward direction. The result was that the light was completely cut off when they met at the exact center of the aperture. This means that the time, or the distance through which the blade had to travel to affect complete cut-off of the light, was reduced by one-half. A similar saving occurred as the shutters left the light, and thus made quite an efficient device, comparatively speaking.

A further advantage here was the fact that the shutter did not move up and down when the picture was framed, but rotated in the one position regardless of where the framing carriage was. The Edengraph also had this feature, although the shutter was only of the ordinary two-blade variety, but it was larger than the Edison shutter.

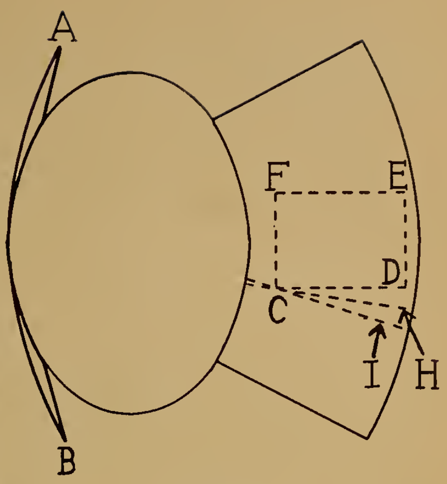


FIGURE 6

(TO BE CONCLUDED)

THE EFFECT OF ELECTRIC SHOCK UPON THE HEART

By *L. P. FERRIS*

MEMBER, TECHNICAL STAFF, BELL TELEPHONE LABORATORIES

EXPERIMENTAL investigations of the effects of electric shock on living things long antedate all commercial uses of electricity, but this work of the early experimenters left much to be desired, particularly in defining the limits of shock which are dangerous to man. As a basis for the development of protective measures and practices, such knowledge is obviously important. To obtain some of the needed data a joint investigation by the Department of Physiology of Columbia University and the American Telephone and Telegraph Company was initiated in 1927 and has since been continued with the help of Bell Telephone Laboratories.*

In seeking a value of current which if exceeded would be dangerous to man, it is important to consider for different practical conditions the effects which are brought about as the current is increased. The threshold of sensation is reached at about one milliampere for a frequency of 60 cycles. Other investigators have found that with 15 milliamperes from hand to hand a subject is unable to release himself. Any currents which prevent voluntary control of the muscles are dangerous because their pathway might include the respiratory muscles and stop breathing.

No serious or permanent after-effects are likely merely from the cessation of respiration, provided it is not continued beyond the point where the victim can be resuscitated by artificial respiration. Currents somewhat greater than those just necessary to stop breathing may derange heart action and cause fatalities even though the duration of such shocks is but a few seconds or less, far too short to be important from the standpoint of interruption of respiration, and obviously too short to give any opportunity for rescue before the end of the shock.

Effect of Ventricular Fibrillation

Death in these cases is brought about by ventricular fibrillation, in which condition the ventricular muscle fibers of the heart contract in an uncoordinated manner, twitching and quivering, in contrast to their normal coordinated rhyth-

(*Continued on page* 32)

*Drs. H. B. Williams and B. G. King of Columbia University have cooperated throughout this investigation with P. W. Spence of the Bell Laboratories and the author. The experimental work has been for the most part conducted in the Physiology Laboratories at the Medical Center by Mr. Spence, Dr. King and assistants. Mr M. E. Strieby of Bell Laboratories participated in the early part of the investigation.

IMPROVE G. E. COPPER-OXIDE UNITS: DATA ON USE, INSTALLATION AND MAINTENANCE

By *C. E. HAMANN*

COMMERCIAL ENGINEER, GENERAL ELECTRIC COMPANY

G-E copper-oxide rectifiers for projection service are now available in several new models, embodying the same principles of rectification used in the older models to which a number of refinements and improvements have been added. The same output ratings have been maintained in the new line: a 40- to 50-ampere unit for the 6—7-mm. Suprex trim; a 40- to 65-ampere unit suitable for use with either the 6—7-mm. or the 6.5—8-mm. Suprex trim, and a 20- to 30-ampere, 50- to 55-volt unit for low-intensity lamps.

Stock models are to be designed for operation on 230-volt, 60-cycle, 3-phase, a-c. supply. Other a-c. voltages and frequencies in either 2- or 3-phase can be supplied on order. Two-phase rectifiers differ only in the transformer construction. A two-unit, Scott-connected transformer is used, which changes the 2-phase to 3-phase, so that the d-c. characteristics are identical with those of the standard 3-phase rectifier and the same smooth d-c. output is obtained.

One noteworthy feature of the new line is the two-piece construction. The c.-o. elements are assembled in the base section together with the blower system and the control relays. A separate top section contains the transformer assembly and control panel. Either section can be easily handled by one man.

Same Number of Elements

The new models retain the same number of c.-o. elements for the respective ratings as the previous models, thus assuring maximum life and operating efficiency. A new method of mounting the c.-o. unit has been developed (Fig. 2). The individual stacks or units are supported at each end by a heavy steel bracket or hanger. These hangers are so arranged that they form the electrical connections to the stacks. The stacks are interconnected by heavy copper bus bars bolted to the hangers, eliminating a multiplicity of connecting wires and soldered joints used in the conventional method of assembly.

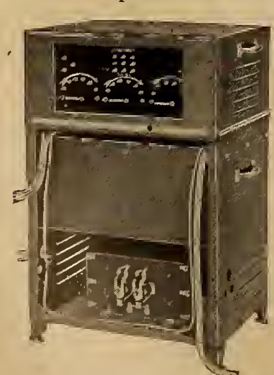


FIGURE 1
View showing method of installing top section onto bottom

Each transformer unit has the primary tapped for 250, 230, 210 and 190 volts, providing ample adjustment for practically any line-voltage condition that might be encountered. Secondary taps permit adjustment of the d-c volts and amperes in eight steps. Fig. 3 shows the output regulation for each of the 8 steps on the 65-ampere unit. Both primary and secondary taps are on a conveniently located control panel in the top section and are clearly marked for identification. Tap connections are made by copper straps instead of flexible wire leads, thus eliminating another possible source of trouble.

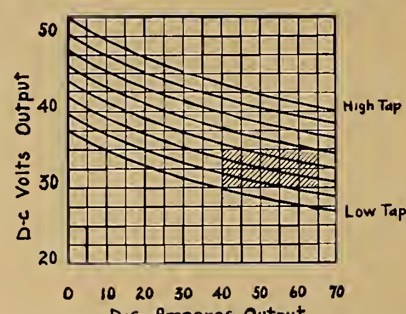


FIGURE 3
Output regulation curves for each of the 8 adjustment steps of the 65-ampere rectifier

Directions for Installation

The rectifiers may be installed in any convenient location. Cool and quiet in operation, many theatres prefer to locate the rectifiers in the projection room. This reduces the amount of wiring to a minimum. However, a simple remote control system gives the projectionist finger-tip control, even though the rectifiers may be located at some remote point.

FIGURE 2
Showing bottom section of rectifier with front cover removed. One copper-oxide stack partly removed to show method of assembly

Conduit outlets are provided on both the left and the right sides of the casing. Duplicate terminals will be found on both left and right sides of the terminal board so that connections to the 3-phase a-c. line may be easily made from whichever side the conduit is attached. Two terminals at the bottom of the board are for the 110-volt, single-phase control line. The d-c. lines to the lamp are connected directly to the + and — terminals on the copper oxide unit assembly.

The general scheme for the external wiring is shown in Fig. 5. The wire sizes given in the table should be maintained to prevent excessive drop in voltage and consequent power loss. The internal wiring diagram of the rectifier is shown above in Fig. 6.

Control of the rectifier is merely a matter of opening or closing the 110-volt a-c. control circuit. This, in turn, starts the blower motor and closes the relays, automatically connecting the 3-phase line to the transformer.

The rectifier should be connected directly to the arc and the pedestal switch wired up to operate the control circuit. This insures that the rectifier is shut down when the lamp is not running, resulting in maximum operating economy. Also, the projectionist follows the customary sequence of operations in starting up and shutting down his lamps and, therefore, having no new operations to confuse or distract him.

The rectifiers require no time for

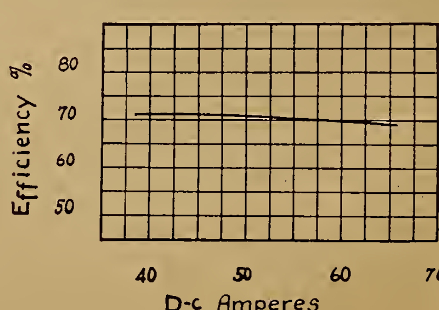


FIGURE 4
Overall efficiency of 88F rectifier

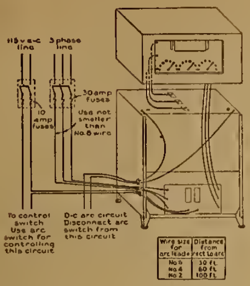


FIGURE 5
Installation diagram for Type 88F rectifier

starting. Power is available at the lamp the instant the control switch is closed.

Adjustments Few and Simple

On this type of rectifier, the adjustments are few and exceedingly simple. The primary taps on the control panel should be set to correspond with the a-c. line voltage available. The secondary taps are arranged in semi-circular form with arrows to show the direction for increasing the output.

When adjusting the d-c. output, use a reliable d-c. ammeter connected in the arc circuit. This is important, as the ammeter on the projection lamp may read low (due to its close proximity to the large magnet which is generally used for steadying the arc flame.) Units are shipped from the factory with connections made to the lowest tap. The initial test should be made on the lowest setting and after the output has been determined, it may be raised step by step until the desired output has been obtained.

The maximum rated current output, as indicated on the rectifier nameplate, must not be exceeded.

Maintenance Requisites

G-E c.-o. rectifiers are conservatively designed and should have unlimited life if properly operated and not overloaded or otherwise abused. In the new models, each individual section of the c.-o. unit is separately fused so that if any of the sections are accidentally short-circuited, or damaged in any way, the other sections will not be affected and the rectifier will continue to operate without any interruption in service. The blower motor is equipped with ball bearings, factory-lubricated and capable of operating continuously for many years without attention.

The overall efficiency of this rectifier is shown in Fig. 4. It should be kept in mind that this represents the actual power delivered to the lamp as compared with the total power taken from the a-c. mains, and includes the power consumed by the blower motor and the control relays.

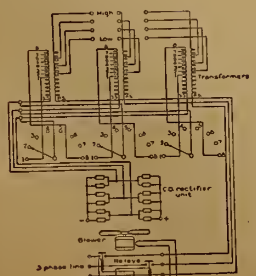


FIGURE 6
Internal wiring of Type 88F rectifier

These rectifiers are conservatively rated and will safely carry the high initial current necessary for striking the arc. However, they *must not* be adjusted for a continuous output in excess of the nameplate rating. The normal operating current of the 6—7-mm. Suprex trim is 40 to 50 amperes, and 50 to 65 amperes for the 6.5—8-mm. trim. The rectifiers must be adjusted so that the arc current is maintained within these limits. If the arc current is too low the positive crater will burn shallow and the light will be poor and not uniform in color.

Excessive Current Harmful

On the other hand, if the arc current is in excess of the limits shown for the respective sizes of carbons, the crater will burn too deeply, resulting in an unsteady, wavering light of much poorer quality than that obtained at normal currents. Maximum screen light is obtained when the arc is operated near the upper limit of the current range. It is a mistake, however, to operate at a point where the screen light is excessive, as it tends to emphasize any defects or scratches in the film as well as irregularities in the projection equipment. Furthermore, carbon consumption is practically doubled between the low and high limits of the current range.

Obviously, the most economical point to operate is near the low current limit,

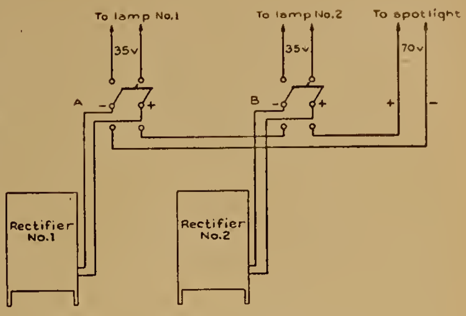


FIGURE 7
Series connection of two 35-volt rectifiers for operating 50- to 75-volt spotlight

although maximum light is obtained near the upper limit of air current. The answer is to select a point where screen illumination is satisfactory without being too intense and, in this way, keep current cost and carbon consumption to a minimum.

Most spot lights are designed to operate from a 70- to 80-volt d.c. with ballast rheostats to drop the voltage to 50 to 55 volts. With a pair of G-E rectifiers, it is possible to obtain the necessary voltage for operating a spot by merely connecting the output of the two rectifiers in series. Fig. 7 shows a simple switching arrangement for accomplishing this.

U. OF F. PROJECTION SHORT COURSE: ITS ORGANIZATION, CONDUCT AND FINE RESULTS

By *JOSEPH A. CAMPBELL*

MEMBER, LOCAL UNION 316, MIAMI, FLORIDA

The Short Course in Projection offered recently at the University of Florida, Extension Division, exclusively for I. A. members was described briefly herein last month. This description failed utterly to convey the full import of these novel training sessions, not only to Florida projectionists but to the craft at large. Nor did it convey any idea of the furor created by this idea among Southern projectionists, from among whose ranks repercussions stemming from the Course still are being felt.

To minimize the importance of this Course, and to withhold details of its organization, conduct and gratifying results would be to render the craft a disservice; thus I. P. presents in the appended article the report of an active participant in the development and execution of the plan.—*Editor.*

WHEN Dean C. Riley, of the General Extension Division, Univ. of Florida, recently offered the locals of our State a short course in projection, I. A. men were shocked right out of their sensibilities. Something just *had* to be wrong, the general opinion being that the University was attempting to get I. A. endorsement for a school to *create* more projectionists!

The Dean was equally shocked when he learned of the indifference shown the idea and the difficulties encountered by his field agent. Undaunted, he persisted in his efforts and invited each Local to send a representative to discuss organization of the School, its conduct and the equipment and facilities needed. The delegates assembled on Nov. 14 at Camp Roosevelt, Fla., site of the much-discussed Cross-State Canal.

Dean Riley's opening address was a successful attempt to win over the delegates to his idea: he explained the purpose of the plan, which offered an opportunity for study to a group of men already employed but who for various reasons had been denied the privilege of higher education. He stressed his disapproval of the idea of training new workers to further burden an already overcrowded field, and expected that his ideas would be regarded as radical. However, this might be, he continued, state universities are financed by all the people, workers included, and their facilities should be extended to all, its doors closed to none. Was his plan an experiment? Certainly; which was precisely why he was determined to see it through.

The Dean concluded by suggesting

that the delegates elect a chairman who would be placed on the University payroll at his customary weekly salary! We were informed that the resources of the University were ours. What did we want? Did we want theoretical or practical instruction? Did we want University instructors?—although Dean Riley opined that men in our own field naturally would serve the purpose better. We agreed; but just how to go about getting these "men in our own field"? How could manufacturers be contacted and convinced of the real purpose and value of the course?

Manufacturers' Splendid Aid

The response to the invitation was most heartening, the only question posed being: "Is the course endorsed by the I. A.?" When the first session opened there was more than $12,000 worth of new equipment on hand. The manufacturers who cooperated can not be praised too much, and without their aid the course surely would have been a failure. Their spirit was excellent: not one word of criticism anent competitive equipment was heard, and those present acted as real instructors, *not salesmen.*

One incident made a distinctly favorable impression on all participants. Harry Strong having been taken ill on his way to the school, Messrs. J. E. McAuley and Karl Brenkert, competitors of Strong, assembled the latter's lamp and did everything possible to give as clear instructions of his product as they did of their own.

Classes were scheduled daily from 10 a.m. until noon, and from 1:30 until 5:30 p.m. Thirty I. A. members were in attendance, with Robert Gavin as chairman. Dean Riley opened the course and made a deep impression by his obviously sincere wish that the sessions be crowned with success. A brief resume of the manner in which the classes were conducted should prove of interest.

P. A. King, district representative for National Carbon Co., started proceedings with a lecture on carbons, their manufacture and use. He used two-reel sound film and many slides. Questioning by the class was encouraged, and every point raised was discussed in detail. Characteristics of many types of carbons were covered, and a handbook was distributed.

In the afternoon J. E. McAuley, president of the company bearing his name, spoke for four hours on lamp construction, projection optics—lenses, condensers, and reflectors—and the many types of carbon combinations, their uses and relative efficiencies. His lecture gave the class a marvelous insight into projection optics. The latest Peerless Magnarc lamp was displyed.

Charles Kaufman, of Erpi opened the second class day with a comprehensive lecture on sound recording and reproduction, and cited the value of recent improvements to the projectionist. Later in the day he covered various types of sound heads, amplifiers and speakers. Questions by the class developed more fully many of the points made. Many illustrations were used in the talk. Mr. R. E. Ward discussed and demonstrated various Weston meters, a full line of which was placed at the disposal of the class.

Karl Brenkert displayed the latest type Brenkert Enarc and gave a splendid lecture on high-intensity arc lamps, their construction and operation. He discussed in detail the theory of the Suprex arc, its action and means for proper control. He discussed also points relating to optics not previously covered, touching upon the speed of lenses and the importance of correct lenses for the different types of light sources.

The third day was devoted largely to

(*Continued on page* 30)

SOUND PICTURES IN 1937

By *EDWIN HARTLEY*
Manager, RCA Photophone

SOUND, both in the studio and in the theatre, will come in for an increasing amount of attention during the coming year. In 1936, important advances in sound recording technique, as exemplified in the ultraviolet and push-pull recording processes, bridged the gap from the great engineering laboratories to the recording studios of the major picture companies. The year 1937 will witness the fruition of the efforts of the research and development engineers in the vastly improved sound recording which will emanate from these studios.

There is every indication that the motion picture studios will cooperate in establishing uniform recording standards in keeping with the new and improved sound technique.

It has already been demonstrated that good sound makes for good box-office returns. Theatre owners and managers who have not already done so must therefore prepare to re-create this vastly improved sound in their theatres. More than ten years of sound-movies have educated audiences to recognize the difference between good and bad sound.

The advent of the improved sound pictures in the coming year will serve to emphasize the shortcomings of obsolete equipment and accentuate the capabilities of the modern systems which have been designed to get the most out of the sound track. The new sound will require greater power to handle climatic moments without distortion, and noise-free amplifier systems of recent design.

The year 1936 witnessed another great technical contribution to realistic theatre sound with the introduction of the cellular type, directional loudspeakers which distribute the entire range of sound uniformly to every section of the theatre. Thus the ideal theatre installation must include the standard rotary stabilizer soundhead for constant film motion, high fidelity amplifiers of sufficient power, and the new directional loudspeakers.

SOUND PICTURES in 1937

By *C. W. BUNN*
Electrical Research Products

SOUND production practice has undergone radical changes during 1936. Re-recording has been vastly simplified through the adoption of machines designed specifically for this highly specialized function. Modern printing practice calls for special "pre-equalizing" to compensate for the losses of the higher frequencies normally experienced in transferring the negative sound image to the release print.

As a result of these and similar changes the release print frequency range has been greatly extended with a marked potential increase in both naturalness and "presence" or the illusion of sound depth. But probably the most important and spectacular change brought about in 1936 has been the marked increase in the use of dramatic sound effects. Earthquake scenes, violent explosions, crashing buildings and similar massive sound values have all been made commercially possible this year by virtue of modifications in the speed of noise reduction unit operation, changes in the geometry of the light valve "slit" and refinements in film processing.

Box-office records show definitely that where reproduction standards have kept pace with advanced release print values, increased revenues have far more than compensated the industry for its enterprise.

Reproducer sets have been refined until they challenge the finest of Hollywood's recording machines. Amplifiers are available that not only transmit the complete audible spectrum but that are capable of delivering sound energy equalling the original in intensity. And in the new W. E. di-phonic loudspeaker a radiating mechanism is found that, within the limits of a monaural sound system, approaches the ultimate.

The exhibitor has been entirely justified in his exacting demands of Hollywood but this interest in the production phases of the business should not be permitted to obscure the possibilities of increased revenue to be found in a completely modernized projection room.

COMMON AND UNCOMMON TERMS IN SOUND PICTURE WORK

By *AARON NADELL*

UNFAMILIAR words encountered in studying sound reproduction may prevent an understanding of some very simple development or design. Fortunately, there is no language easier to understand than electrical language, most of the units and terms being interrelated. The language did not grow up by itself, but was skillfully invented and improved in a long series of international conferences. Many of the words of which it consists were carefully chosen to bear a simple relationship to each other. Those relationships were determined not only for clarity but for ease of computation.

There is a possible source of confusion, encountered on rare occasions, owing to the fact that there is more than one volt, more than one ampere, and so on. The differences are due to disagreement as to just which system of nomenclature and measurement would be most convenient. Thus, the international volt is 1.00043 times the "absolute" volt. This complication is mentioned here only because the reader may at some time or other be misled by it, if he does not know it exists. The international or practical units are the ones with which the projectionist is primarily concerned, and the ones in which all his instruments are calibrated. These are the units discussed herein.

Electrical Terms

The familiar volt, ampere, *etc.*, should be thoroughly understood for the sake of a better understanding of the secondary terms that are based on them.

AMPERE. There is a common misunderstanding about the *ampere.* It does *not* represent a quantity of electricity. The unit of electrical quantity is the *coulomb.* An ampere is the flow of one coulomb per second past a given point.

The coulomb is the quantity of electricity needed to perform a certain measurable amount of electroplating, in a certain standard solution. If that work is done in a second's time, the flow of current in the solution is one ampere. If it is done in one-half second time, the current is two amperes. If the same work takes a minute, the current is 1/60th ampere; and so on.

Similarly in a wire: if ten coulombs pass in one second, the current is 10 amperes; if ten coulombs pass in one-tenth second, the current is 100 amperes; and so on.

OHM. One *ohm* is the resistance offered to the flow of current by a standard resistor—a column of mercury of definite length and cross-section, at a definite temperature. As in the case of the ampere, the unit chosen is based on apparatus that can be built easily and accurately in a simple laboratory.

VOLT. The *volt* is the unit of electrical pressure, and such pressure can be created in several ways. It may arise out of the mutual repulsion which electrons (all being negative), have for each other, or from the attraction between electrons and some place which holds less than the average or earth charge of electrons, and is therefore positive; or from both causes. Magnetic force suitably applied also creates electrical pressure, which in this case is sometimes called electromotive force, and is measured in volts by its effect in creating a measurable current flow through a known resistance.

To simplify the calculations of Ohm's Law, it has been decided that one volt shall be that pressure which makes one ampere flow through one ohm. This is one example of the intentional and planned simplicity of electrical language. If some other standard had been chosen for the volt, so that one volt would, for example, cause two amperes to flow through an ohm, the familiar law would become $IR = \frac{E}{2}$; and still other standards might introduce more complicated fractions. The matter has actually been made as easy as possible; although the different values of volts, ohms and so on that exist and are encountered occasionally are based on the conviction of some scientists that still simpler arrangements are possible—not for Ohm's Law, but for other calculations which occur in electrical work.

So-called "common terms" used in one's everyday work not infrequently become so common, sometimes through careless application, as to lose much of their original meaning—that is, to the user. Also, the true significance of many terms and their relation to others has entirely escaped the indifferent student. All of which warrants the occasional restatement of terms and their meanings such as is contained in the accompanying article.

A secondary basis for the volt has been found in the Weston or standard cell, a battery in which the voltage remains absolutely constant to the point of complete exhaustion. The international volt is sometimes described as a definite fraction of the potential difference maintained by a standard cell.

These three basic units—volt, coulomb and ohm—are the foundation on which the majority of other electrical terms are based, as will be seen subsequently.

HENRY. When current through a choke coil changes in value, the coil behaves like a single-winding transformer. If the current falls off, an electromotive force is generated in the wire that adds to the original voltage. If the current increases in strength, a counter-electromotive force is generated in opposition to the original voltage. Such coils are therefore used as filters in amplifier circuits, to smooth out the ripple in d.c. drawn from a vacuum tube or copper-oxide rectifier. Their effectiveness is called their *inductance*, and is measured in *henries.*

Consider a coil in which the rate of current change (not the rate of flow but of *change in flow*) is one ampere per second. Then if the electromotive force generated in that coil is one volt, the inductance is one henry. If the inductively-generated voltage is only 1/1000th volt, the inductance is one *millihenry*, and so on.

FARAD and MICROFARAD. The charge absorbed by a condenser depends upon the voltage applied. The greater the voltage, the greater the amount of electricity that will be forced upon the plates —until the voltage becomes high enough to break down the insulation. Hence the capacitance of a condenser cannot be measured by the amount of electricity it will absorb, but only by the amount

it will absorb at some given voltage.

When one volt can force one coulomb upon the plates, the capacitance of the condenser is one *farad.*

The farad is the unit chosen for convenience in calculation. For practical purposes it is much too large. The condensers used by the projectionist are rated in *microfarads*, or in fractions of a microfarad. The capacitance of a condenser is one microfarad when one volt of pressure will force one-millionth of a coulomb upon the plates.

Reactance. Reactance, like resistance, is measured in ohms. Reactance does not exist in a purely d.c. circuit. Direct current does not flow at all through a condenser, and on the other hand is not affected by a choke coil (aside from the ordinary resistance offered by the wire of the coil), as long as it does not change in value. Hence the value of any d.c. is equal to $\frac{E}{R}$, R being the ordinary resistance of the conductor. But a choke coil tends, by generating counter-electromotive forces, to hold back alternating current. Similarly a condenser limits the flow of a.c. in accordance with its capacitance. If the voltage applied to either unit is measured, and the current flowing through the unit is measured, the reactance of the unit (its effect in limiting current flow) is the same as $\frac{E}{I}$ ohms.

The coil is said to have *inductive reactance*, and the capacitor to have *condensive reactance.*

Impedance. An a.c. circuit very often contains inductors, condensers and resistors. The net effect of all the influences that limit current flow in an a.c. circuit is called the *impedance.* Measuring the voltage applied to the entire circuit, and the current through it, will give the impedance as $\frac{E}{I}$. Impedance, like the resistance and reactance which go to constitute it, is measured in ohms.

In practical work of interest to the projectionist, impedance is related to the frequency of the alternating current, and in matching speakers to an amplifier, *etc.*, it is necessary to know not only the impedance of each unit but the frequency at which the impedance is taken. Straight resistance is the same at all frequencies, but reactance (and therefore impedance) are not.

The reactance of an inductive winding is $2\pi fL$, in which π of course is 3.14159, L is the inductance of the coil in henries, and f is the frequency of the current. The reactance of a condenser is $\frac{1}{2\pi fC}$, C being the capacitance in farads. For either, the reactance will be different at different frequencies — higher in the case of the coil as the frequency increases, and higher in the case of the condenser as the frequency declines.

Projectionists are familiar with these facts, even when the formulas for them are new. They know that a choke coil offers the greatest opposition to high frequencies, and a condenser to low frequencies. But since reactance varies with frequency, any impedance that consists wholly or partly of reactance must also vary with frequency; and impedance ratings of sound equipment are meaningless unless the frequency on which the rating is based is known. Four hundred, eight hundred and a thousand cycles are the frequencies used by different manufacturers in citing the impedance values of their apparatus.

Phase. When the voltage applied across a resistor varies, the current through that resistor varies simultaneously; but the same is not true of inductors and capacitors. When the voltage applied across a choke coil is changed, a counter-electromotive force is generated which delays the corresponding change in current. When voltage is applied across a condenser, there is an immediate flow of current into the plates—the condenser acting momentarily as a short-circuit across the voltage source.

In the first case the voltage "leads" the current; in the second, the flow of current precedes the establishment of a potential difference across the condenser —i.e., leads the voltage. In both cases current and voltage fail to keep step, as they do in a resistor, but are out of phase with each other. In a circuit containing both reactance and resistance, the phase difference, or "phase angle", depends on the relative values of the inductors, capacitors and resistors involved.

Watt. The watt is the unit of work done, in a d.c. circuit, by one ampere flowing through one ohm. If the ohm is a straight resistance, the work done can be measured by the temperature rise of the resistor. From the foregoing it is obvious that one watt equals one ampere multiplied by one volt, which is the pressure that will drive one ampere through one ohm.

In an a.c. circuit one watt is also equal to one volt times one ampere, provided the voltage and current are wholly in phase. If they are out of phase, the work done will not be as great as that in a d.c. circuit in which one ampere is driven by one volt. The loss of work will be equivalent to the extent of the phase difference. Hence, it is not possible, in an a.c. circuit, to measure the wattage (work done) by multiplying current and voltage. The actual work is often less than the multiplication indicates it should be.

Power Factor. The ratio between the

16,258 Motion Picture Houses Operating in U. S.

There were 16,258 theatres in operation in the United States, as of January 1 last, an increase of 880 over the previous year, according to a survey completed recently by the Film Boards of Trade. This latest figure compares with 14,750 active theatres as of January 1, 1932.

Theatres now operating have an aggregate of 10,440.632 seats, representing an increase of 341,712 within one year, the survey shows. Two years ago there were slightly less than 10 million seats available.

At the present time, sound-equipped theatres total 17,915, as against 903 silent houses, it is shown. There are 1 693 sound theatres and 867 silent theatres dark. About 300 former silent houses are now occasionally used with portable sound equipment.

Appended hereto is the result of the nation-wide theatre survey:

Territory	Total Theaters			Closed Theaters			Theaters In Operation	Circuit Theaters Affiliated	Circuit Theaters Unaffiliated	Independent Theaters
	No.	Sound	Silent	No.	Sound	Silent	No.	No.	No.	No.
ALBANY	406	341	65	119	60	59	287	28	74	304
ATLANTA	761	761	0	32	32	0	729	159	238	364
BOSTON	1,101	919	182	385	203	182	716	138	212	751
BUFFALO	451	438	13	129	116.	13	322	44	100	307
CHARLOTTE	509	508	1	57	56	1	452	81	65	363
CHICAGO	887	882	5	133	128	5	754	126	241	520
CINCINNATI	1,041	955	86	161	75	86	880	66	145	830
CLEVELAND	546	523	23	59	36	23	487	39	173	334
DALLAS	925	906	19	68	49	19	857	187	213	525
DENVER	435	435	0	39	39	0	396	66	78	291
DES MOINES	398	398	0	36	36	0	362	33	64	301
DETROIT	558	558	0	35	35	0	523	108	68	382
INDIANAPOLIS	543	506	37	68	31	37	475	4	133	406
KANSAS CITY	784	704	80	179	99	80	605	96	97	591
LOS ANGELES	603	559	44	83	39	44	520	168	103	332
MEMPHIS	334	334	0	27	27	0	307	32	77	225
MILWAUKEE	543	457	86	136	64	72	407	78	25	440
MINNEAPOLIS	960	943	17	81	64	17	879	89	99	772
NEW HAVEN	185	185	0	13	13	0	172	52	24	109
NEW ORLEANS	545	490	55	97	44	53	448	58	111	376
NEW YORK	1,164	1,144	20	117	97	20	1,047	183	528	453
OKLAHOMA CITY	442	442	0	13	13	0	429	10	104	328
OMAHA	464	462	2	44	42	2	420	31	55	378
PHILADELPHIA	798	798	0	34	34	0	764	190	151	457
PITTSBURGH	684	665	19	58	39	19	626	75	146	463
PORTLAND	208	208	0	3	3	0	205	21	28	159
ST. LOUIS	566	557	9	95	86	9	471	33	159	374
SALT LAKE CITY	587	454	133	161	42	119	426	53	63	471
SAN FRANCISCO	457	454	3	48	45	3	409	51	126	280
SATTLE	305	305	0	14	14	0	291	27	91	187
WASHINGTON	628	624	4	36	32	4	592	71	119	438
TOTAL	18,818	17,915	903	2,560	1,693	867	16,258	2,397	3,910	12,511

actual work done, in an a.c. circuit, and the figure obtained through multiplying voltage by current, is the *power factor*. Hence, a.c. wattage is not taken as volts times amperes, but as volts times amperes times power factor. When voltage and current are completely in phase, the power factor is 1, and the volt-ampere and wattage ratings are the same. The projectionist will sometimes find that a.c. equipment with which he has to deal is rated in volt-amperes and not in watts. For some purposes, that method is more convenient and practical.

Magnetic Terms

RELUCTANCE. The opposition offered by the medium to the flow of magnetic flux (comparable to electrical resistance), is the reluctance. The *oersted* is the reluctance offered by one cubic centimeter of air.

GILBERT. The gilbert is the unit of magnetomotive force (magnetic "voltage"). The force developed by an electro-magnet of one ampere-turn of wire is 1.257 gilberts.

LINE OF FORCE, MAXWELL. The line of force (magnetic "amperage") is the flux that exists when one gilbert operates through a reluctance of one oersted. The line of force is also called the *maxwell*.

UNIT POLE. If two equal magnetic poles, separated in air by a distance of one centimeter, attract or repel each other with a force of one dyne, they are unit poles, or poles of unit strength.

GAUSS. In an electrical circuit, the size of the wire that carries the current is seldom of much importance, as long as the wire is large enough not to offer excessive resistance. In the case of magnetic flux, however, it is often very important to know not merely the flux strength in maxwells, but what that strength is *per given area*. One maxwell per square centimeter is one gauss.

Terms of Amplification

AMPLIFICATION FACTOR. When the plate voltage of a vacuum tube changes, the plate current changes in accordance with Ohm's Law. When the control grid voltage of a tube changes, there is also a change in plate current. The *amplification factor* expresses the ratio between control grid voltage change and plate voltage change, both of which have the same effect upon plate current. Thus, if a control grid voltage change influences plate current as much as a ten times greater change in plate voltage, the amplification factor of the tube is ten. Many tubes have amplification factors of several hundred, or of a thousand or more. That of the new 6C6 tube, for example, is 1185.

MU. Same as amplification factor.

MUTUAL CONDUCTANCE. This is *not* the same as mu, but is designated as G_m—Gee sub-em, the ratio of the change in plate current of a tube (in amperes) to the change (in volts) of grid bias that produced it. The unit of mutual conductance is the *mho* (ohm reversed); the practical unit (as in the case of the farad) is the *micromho*. Consider a grid change of 2 volts, resulting in a plate current change of 2 milliamperes—2/1000th ampere. The mutual conductance is 2/1000 divided by 2, or 1/1000 mho. Since the micromho is a million times the mho, the mutual conductance is 1,000 micromhos.

GAIN. Change in current, power or voltage. Gain usually implies an increase, but is also used to express loss. Thus the gain of an amplifier may be 70 decibels, or the loss in a volume control may be expressed as a gain of *minus* 10 decibels.

LEVEL. Level, like gain, is expressed in decibels, sometimes also in watts. The gain indicates the increase or (sometimes) the decrease in power, current or voltage. The level merely states what is the power, voltage or current. Thus the input level to an amplifier may be —100 decibels, the gain of the amplifier may be 50 decibels, and the output level therefore is —50 db. The next piece of apparatus may be a volume control introducing a loss of 10 db (or gain of —10 db), at the output of which the level has been reduced to —60. An amplifier with a gain of 80 will then produce an output level of *plus* 20.

DECIBEL. The decibel, or db, has been discussed in detail herein[1]. It expresses a comparison. The comparison may be one of amplification, that is, of output as against input, or it may be one with some previously agreed-upon standard. When the decibel expresses a level, it compares that level with some standard already determined upon. There are several standards in use at the present time, but the projectionist is most likely to encounter those of .006 and .01 watt. The former is used by W. E. and the latter by RCA. Other manufacturers of sound apparatus are divided in their preference. The standard is called zero level. All other sound levels are then described as so and so many db above or below zero level.

FREQUENCY. This is the number of times per second an alternating current reverses its direction of flow, as expressed in:

CYCLES. Consider any wire carrying a.c., in which the current is just beginning to flow from left to right. It increases in value and then declines again to zero: at that moment it has completed one alternation. Now the current commences to flow from right to left, rising in value and declining again. At the moment before it begins to flow once more from left to right, it has completed one cycle.

[1] I.P. for July, 1933, P. 17.

AUDIO FREQUENCY. Audio frequencies are currents (or voltages) the frequencies of which are the same as those frequencies of air vibration which the human ear can perceive—roughly, from 16 to 16,000 cycles per second.

FREQUENCY RANGE. The extent of sound frequencies that can be covered by an amplifier or other articles of sound equipment. Apparatus is often described as having a frequency range of between such-and-such frequencies, which type of rating is meaningless, unless it states whether all frequencies within the range are treated identically by the equipment in question. They seldom will be; and the extent of emphasis or discrimination within the range the equipment is rated to cover should be stated also. The facts are most conveniently conveyed by means of:

FREQUENCY RESPONSE CURVE. More simply stated, this is a response curve—a graphic statement of the operation of sound equipment upon all frequencies within the range for which the apparatus is designed. The curve takes the form of an irregular line drawn on graph paper. If the line is perfectly straight and horizontal the equipment represented by it is:

FLAT, within the designated limits of frequency. The equipment is flat in its frequency response when it treats all sound frequencies alike.

HARMONIC CONTENT. The action of a sound amplifier introduces into the output a form of distortion which is identical in nature which the presence of certain spurious sound frequencies that are non-existent in the input. This form of distortion is treated in every way as if the amplifier had added, to the frequencies presented to it, other frequencies which stand in harmonic, or simple arithmetical, relationship to the originals. The presence of this form of distortion is spoken of as harmonic content. That amplifier is the best which introduces into the sound the smallest harmonic content, in proportion to the volume of original sound. This term has been explained in detail in I. P. for Dec., 1936, p. 21.

Re: A 'Swell Job'

Contained in a subscription renewal letter to I. P. is the following:

"We think you are doing a swell job, and we thought you knew it. Pardon our tardy acknowledgment of your efforts. For the first time in our history we have a craft organ that is free to say what it thinks—and does!

ROY L. BRAINERD
Sec., L. U. 509, Duluth, Minn.

REQUISITES FOR THE PROJECTION OF LENTICULAR COLOR FILM

By *J. G. CAPSTAFF, O. E. MILLER* and *L. S. WILDER*

RESEARCH LABORATORIES, EASTMAN KODAK COMPANY

In the lenticular film process the film base is covered with microscopic lenses which form images of three color filters on the film. It follows, naturally, that the projection of this film must utilize three filters in order to reproduce an approximation of the original picture photographed. The accompanying article, originally presented as a lecture-demonstration before the S.M.P.E.,* enumerates the severe demands made by this process upon projection facilities, and, incidentally, offers data applicable to projection generally.—Editor.

THE lenticular film color process, in common with other additive color processes, involves a large loss of light by absorption in the color filters necessarily used in the projection system. Therefore, it requires so much more illumination than is needed for projecting black-and-white pictures that it was believed until recently by many persons in the industry that it was impossible to show these pictures properly even in the average theatre, not to mention the *de luxe* houses having screens from 25 to 35 feet in width.

To illustrate the seriousness of the problem, it was estimated that about ten times the normal amount of light would be needed. The color filters used for projection during the earlier experimental work had a transmission of *only* 12 *or* 13 *per cent*, and the intensity was further reduced by the lenticular surface of the film support. The Kodak Research Laboratories recently undertook to make a systematic investigation of the possibilities of lenticular film projection and to give an actual demonstration in a *de luxe* theatre.

A preliminary survey of the problem indicated quite a number of possible ways in which the screen illumination could be increased. Some of these, which were temporarily laid aside for practical reasons, will not be mentioned except in the concluding remarks. With a desire to limit the investigation to the use of already existing projection equipment with only minor alterations, the work was pursued along the following lines:

(1) Reduction of the absorption loss in the color filters.

(2) Modification of the optical system to increase its relative aperture.

(3) Recovery of part of the light lost because of the shutter.

(4) Reduction of the density of the prints.

(5) Improvement in the operating conditions of the illuminating system.

Since the greater part of the light is lost due to absorption in the color filters, the problem of screen brightness becomes progressively easier as the filter transmission is increased. After a certain point, however, the colors of the projected picture begin to lose saturation, and appear "washed out." The color reproduced upon the screen can be of no higher degree of purity than that of the projection filters. As the red filter is made lighter, it soon begins to transmit yellow, and becomes an orange red. With such a filter a good red can not be represented properly upon the screen.

The Optical System

After considerable experimental work with dyes, and a number of observations with filters of different densities, a standard filter was finally adopted that was thought to have the highest transmission it was possible to get without too noticeable loss in color saturation. The transmission of this filter, when used with the high-intensity arc system to be described later, was 22 per cent. This, multiplied by the 80 per cent transmission of the lenticular film support, gives an *overall transmission* of 17.6 per cent. Therefore, the factor by which the normal illumination needs to be increased is 5.8 times.

Fundamental Conditions.—As shown in Fig. 1, the essential elements of a projection system suitable for lenticular color-films are: light-source, collective element, collimator lens, film-gate, projection lens, and color filter. A detailed discussion of the optical relations involved in the use of lenticular films is not within the scope of this paper, and therefore a mere statement is made of the necessary conditions to be observed in practice:

(1) The light-source must be imaged at the film-gate.

(2) The collecting element must be imaged at the color filter.

(3) It is essential that all elements be centered upon the optical axis.

(4) The color filter must be located at the front focus of the projection lens.

It will be obvious that the first three of these are the identical conditions for optimal screen brightness and uniformity, even in black-and-white projection. The fourth condition comes about as a result of a particular optical property of the lenticular color-film itself, and is dependent upon the optical arrangement used in printing.

Projection Lenses. — The greatest single gain in illumination promised to come from increasing the relative aperture beyond the $f/2.5$ systems commonly used. In view of the successful use, in the 16 mm. field, of lenses having relative apertures of $f/1.6$ or better, it was thought that it should be possible to set up a 35 mm. system that would be equally efficient. Two $f/1.6$ lenses were obtained having focal lengths of 120 and 160 millimeters. Except for the somewhat inferior definition of one of them, these lenses were entirly satisfactory for

* Journal of the S.M.P.E. XXVIII, (Feb., 1937) No. 2.

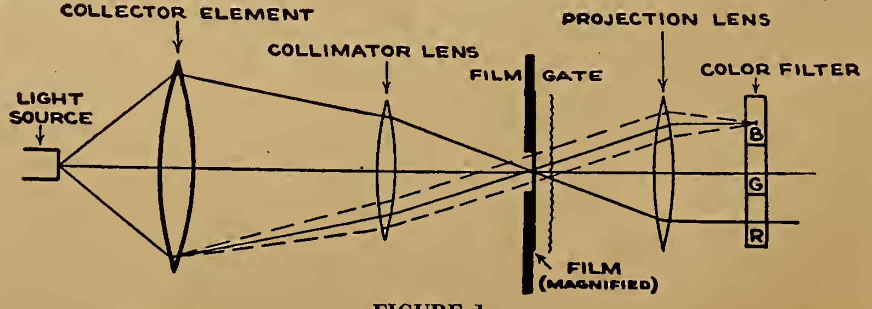


FIGURE 1

Diagram of projection optical system for lenticular color film

the purpose. On account of the much larger diameter of the lens barrel, it was necessary to make a new lens mount for the Simplex projector.

Illuminating Systems.—Before the increased relative aperture could be fully realized, it was necessary to modify the existing illuminating system so as to fill an angle of $f/1.6$ and at the same time to fulfil the conditions necessary for use with lenticular films. The lamp selected for the first experiments was the Peerless Magnarc,* which appeared to be a good example of a high-efficiency reflector system. After a number of optical arrangements had been tried, using reflectors of various focal lengths, it was apparent that the only change necessary was the addition of an inexpensive condenser lens at the front of the lamp house. To avoid breakage due to the extreme heat, this lens was made of pyrex. The complete optical arrangement as it was finally used is shown in Fig. 2, which is drawn approximately to scale.

The regular Magnarc reflector is 14 inches in diameter, and 5¼ inches from the arc crater. The plano surface of the auxiliary condenser is 28 inches from the center of the reflector, and 5¼ inches from the film-gate. The condenser is 4 7/16 inches in diameter and 15 inches in focal length. The addition of this condenser brings the image of the reflector into the plane of the three-color projection filter. The filter is located near the front focal plane of the projection lens, a necessary condition for lenticular film projection. In order to allow the larger cone of illumination from the modified illuminating system clear access to the film-gate, it became necessary to enlarge the apertures in the shutter housing and in the masks back of the aperture plate on the Simplex projector.

When the full $f/1.6$ relative aperture is filled, there should be 2.31 times the screen brightness that is obtained with a corresponding system of relative aperture $f/2.5$. The actual screen brightness obtained with this system was slightly less due to mild imperfections in the quality of the reflector. Certain dark zones appear upon the reflector surface when viewed from the film-gate. This modified Magnarc system was used for a great part of the experimental work and for the demonstrations to be mentioned presently.

* Other lamps on the market similar to this one should be equally suitable.

Magnification of Arc Crater.—It will be contended perhaps that the increase in the relative aperture attained in this way is at the expense of the crater magnification at the film-gate, and that the uniformity in screen brightness will be unsatisfactory. Of course, the crater of the high-intensity arc is not uniform in brightness, being brighter at the center than at the border. For this reason, and also in order to provide some tolerance in the position of the arc, present illuminating systems are made to have a higher magnification than would be necessary just to fill the aperture.

However, when the lenticular color films are projected with the above-described system, the corners of the picture do not appear to be more poorly illuminated than is the case with the average black-and-white system. The reason for this lies in a particular requirement of the camera and projector lenses used in the particular film process. The lenses used in black-and-white work, both in the camera and, to a somewhat less extent, in the projector, cause a falling off in the marginal illumination due to the fact that the lens aperture can not be completely filled for oblique angles.[1] With some of the camera lenses ordinarily used in black-and-white work, this becomes so bad that the corner illumination falls nearly to zero, and results in a print having higher density at the corners than at the center of the picture. When this print is projected, the additional density at the corners adds considerably to the deficiency of corner illumination already present in the projection system.

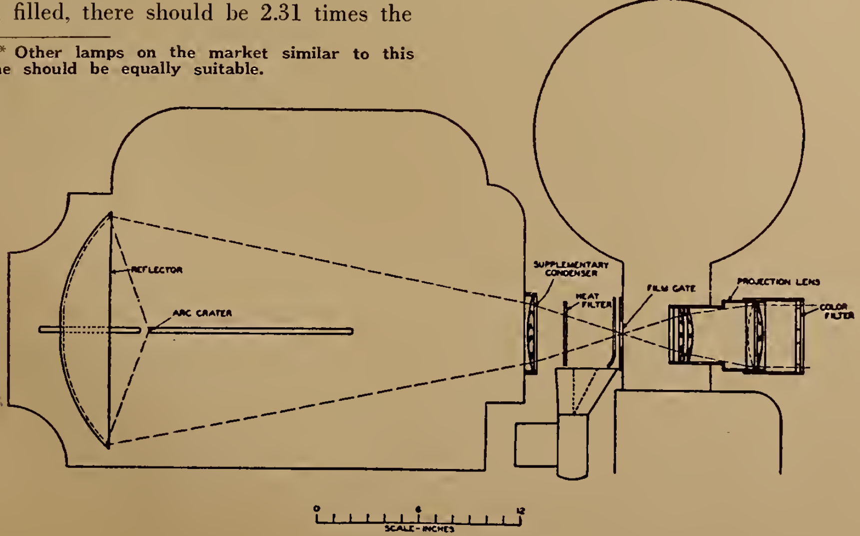


FIGURE 2
Scale drawing of experimental projection system

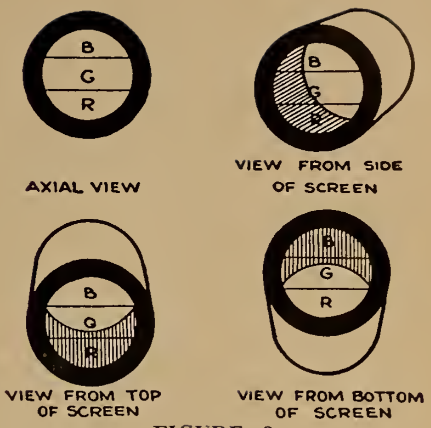


FIGURE 3
Projection lens and color filters seen from different points of the screen, showing cut-off of the filter zones

This property of the lenses becomes objectionable in the lenticular color-film process, but for a different reason, as seen in Fig. 3, which shows different views of the lens and color filters as they would appear when viewed from different points of the screen. Disproportionate areas of the color segments are illuminated for different positions around the margin of the screen, a condition that leads to an uneven distribution of color on the screen and can not be tolerated. Thus, because of the choice of lenses that this makes necessary, one can afford to use a lower magnification of the crater. However, it may be desirable to have a slightly larger crater image than that used in the present system, which could be accomplished by substituting a 9- or 10-mm. carbon for the 8-mm. one now used.

The Heat Problem.—Considering that there are already reports from theatres when using improved black-and-white equipment of too much heat at the picture aperture, it was not surprising to find in the preliminary trials with this more efficient optical system that the film was badly damaged by the terrific heat. Attempts to cool the film by a jet of compressed air were insufficient. Clearly some sort of heat filter had to be used.

Previous experience with water cells did not favor their use in the theatre projection room, so heat-absorbing glass was tried. Used in a single sheet, it broke repeatedly, even though it was of the heat-resisting type. Cutting the glass into ¾-inch strips and mounting the strips side by side prevented breakage; but it was found that the glass would soon melt unless subjected to a current of air. Since too much color in the glass would have been objectionable,

it was necessary to use a density only just sufficient to reduce the heat to a safe value.

The filter finally adopted was in the form of several ¾-inch strips of Corning *Extra-light Aklo,* 2 mm. thick, held loosely side by side in a rectangular metal frame, and cooled by a gentle current of air from a small furnace blower. The location of the filter in the optical system must be such that the edges of the glass strips are not visible upon the screen. In the present instance, the glass was mounted upon the front of the shutter housing at a distance of approximately 3⅜ inches from the film-gate. No trace of the edges of the strips has ever been noticed upon the screen. The air was directed upon both sides of the glass by appropriate baffles.

With this filter, which transmits only 25 or 30 per cent of the total heat energy, the heat at the aperture is actually less than that occurring with some of the better projection lamps now in use. The familiar "biscuit" appearance of projected prints is entirely lacking. Part of the air from the blower is directed upon the film-gate, which gives slight additional cooling to the film and to the metal parts around the aperture.

A Relay Condenser System

To see what could be done with the 120-ampere high-intensity arc used with a condenser system, a Hall & Connelly lamp was set up with a set of 7-inch condensers and a relay system. In a relay system full advantage can be taken of the entire crater surface because it is not imaged at the aperture. Furthermore, advantages can be taken of the fact that the entire crater area emits red light of practically uniform intensity. Since in color work, the limiting color seems to be red, use can be made of the entire crater surface.

The measurements of screen brightness made with this set-up show that it is possible to get equally as bright a screen with the Magnarc system, and it becomes somewhat easier to maintain the screen uniformity. Therefore, where there is sufficient room in the projection room to accommodate the increased length of a relay system, this type of lamp would serve very well. The remarks about to be made about adjustment and operation of the optical system apply equally well to condenser systems and reflector systems.

Adjustment and Operation.—A great number of observations were made with the best types of black-and-white illuminating systems presently in use in order to determine, if possible, what effect the operating conditions and the adjustment and alignment of the optical system had upon screen brightness. Based upon these observations, it is believed probable that the average theatre projector often does not deliver much more than half the screen illumination it is capable of delivering. Losses occur in many ways: accumulation of dirt upon the screen lowers the reflecting power; the reflector or condenser surface facing the arc becomes clouded with smoke, pitted by flying particles, and has to be cleaned constantly in order to preserve the light transmission.

Because of the imperfections in the commercial mirrors and condensers, the screen uniformity is not at its best when the system is adjusted to provide the maximum of screen brightness.[1] The projectionist, therefore, has to sacrifice a considerable amount of screen brightness in order to improve the uniformity. Errors in centering condenser systems can be responsible for appreciable losses of illumination. Some projection lenses in use have a lower transmission than is desirable. Carbon arcs are somewhat erratic in behavior. The crater sometimes burns unevenly, and the crater brightness varies from time to time.

Reduction of Shutter Loss

Substantial improvement could be made in all these operating conditions. Possibly new equipment would have to be designed in order to free the projectionist from the necessity of constantly attending to the adjustments of the various manual controls found upon the present lamps. If the arc operation could be sufficiently stabilized, and the arc crater accurately held to the optical axis, the entire system could be set up and adjusted once for all, and the projectionist would then be required to make only the single adjustment of keeping the arc crater in the correct position along the optical axis. There is no reason, furthermore, why an arrangement using photoelectric cells could not be devised that would make even this adjustment automatically.

Since 50 per cent or more of the incident light is lost at the shutter, it seemed worth while to attempt to recover some of this loss by speeding up the pull-down movement, and using shutter blades of the narrowest possible angle. No originality is claimed for the method used. Inside the housing of the Geneva pull-down mechanism used on all Simplex machines is a pair of small spur gears, through which the intermittent assembly is driven. By substituting a pair of elliptical gears, the intermittent movement was accelerated so that the pull-down period occurred in 52 degrees of the cycle instead of the usual 90 degrees.

Using this in combination with a 45-degree covering blade and a 30-degree flicker blade, a gain of 59 per cent was made in screen illumination. However, it was thought that this was too severe for the film, and a second pair of elliptical gears was prepared that gave a more moderate acceleration to the pull-down mechanism, and accomplished the movement of the film in a 68-degree interval. Using with this a covering blade of 60 degrees and a flicker blade of 40 degrees, a gain of 44 per cent was realized.

However, unless there are certain changes made in projector design that will compensate by reducing the stresses occurring during the pull-down operation, it is doubtful whether application of even this mild degree of acceleration to the Geneva movement is practicable. The Powers movement, however, because of the smooth acceleration, offers possibilities for a quicker pull-down.

The proper size for the shutter blades was arrived at empirically by progressively increasing the width until there was no noticeable flicker or travel-ghost upon the screen at the ordinary brightness level. Advantage was taken in these experiments of the fact that the perceptibility of both flicker and travel is less as one proceeds to lower levels of illumination. If it should later be found necessary to increase the shutter blade slightly, it would represent a loss of only a few per cent. A further discussion of the subject of projector mechanisms is believed outside the scope of the present paper.

Although the work done so far must be regarded as merely preliminary, there seems to be ample ground for believing that more can be done in a practical way to recover a considerable part of the light lost at the shutter. In this connection, moving the shutter to a position very near the film plane so as to effect quicker cut-off of the light-beam would be a worthwhile step. However, in the small neighborhood theatres,

(*Continued on page* 27)

Boston L. U. 182 Awaits Long Reel Ruling

Boston projectionist L. U. 182, lone survivor of organized craft units who fought introduction of the 2000-foot reel, has voted to shape its future course in this respect on the basis of whatever ruling is made by the Mass. Dept. of Public Safety. President Thad C. Barrows released the following statement:

"After four months of splitting the so-called 2000-foot reels, the projectionists of this city feel that they have done more than their share to discourage what they feel certain is a definite fire hazard. We now await the decision of the Dept. of Public Safety as to our future course in this situation.

The reel controversy found L. U. 182 the first to enter the fight against the long reel and the last to withdraw."

SECTIONAL *vs.* NATIONAL LEGISLATIVE EFFORT AS AN AID TO CRAFT

REFLECTIONS UPON A COMMUNICATION FROM W. G. WOODS, SEC., L. U. 162, SAN FRANCISCO

IN THE last (Dec.) issue of I. P. there appear some good and timely articles on film fires, methods of prevention and the projectionists' role under such circumstances—which remarks might well be extended by the addition of comment relating to film fires and projectionists' safety. Our record of film fires during the past two years is two dead and twelve badly injured; while our sister city, Oakland (L. U. 169), has a record of two dead and several injured.

Mark Twain once said: "In case of shipwreck, never get excited, proceed quietly to shore." This product of pure reasoning has been interpreted by the hard-boiled "operator," who has had experiences of his own, to: "In case of fire, don't get excited. Get out!" This is a most excellent paraphrase—except that it has a catch to it.

During a recent projection room fire in this city two of our men just did not get out quickly enough, and found themselves trapped by a wall of fire between them and the usual one projection room door. Retreating to a small generator room, having no exit, they were slowly suffocating from the fumes when the fire department rescue squad reached them and escorted them to safety.

Incident Prompts Second Exit Regulation

A week later when these men got up out of their cozy oxygen tents at the hospital, they found that they had not suffered in vain: for now comes Mr. Ralph Wiley, Chief of the Dept. of Electricity of San Francisco, who has promulgated the rule that in future all projection rooms must have a *second exit*, as well as the usual door, this second exit to be positioned preferably at the opposite side of the room, or in the rear wall, or as a last resort (where necessitated by structural peculiarities) through the roof.

There appears to be no definite ruling on this matter by the National Board of Fire Underwriters, or by (in our case) the State Employees' Compensation Board—although there is a profusion of laws relating to the safety of the audience and to the "vital necessity" for protecting property and the interests of insurance companies.

By this time it is no secret that accident insurance rates for projectionists match those applicable to aviators—which brings me back again to the beginning.

Why not a concerted effort to make projection work safe *for projectionists* by appeals to all agencies regulating projection rooms, as well as to compensation boards, where they exist? Construction work on the Bay bridge here claimed twenty-three lives, prompting the State Compensation Board to order a net rigged under the great Golden Gate bridge structure. Result: the formation of a Half-Way Club, similar to the aviators' Caterpillar Club, comprised of the eleven men who fell from the bridge structure and lived to tell it.

Meanwhile, and this is the point of this little essay, Mr. Wiley's rules designed to protect the projectionist in the event of room fires will receive the backing of this local union—even to the point of NO SAFETY—NO PROJECTIONIST!

W. G. Woods, Secretary, L. U. 162, San Francisco, Calif.

By ***JAMES J. FINN***

FOR the information of Mr. Woods and all others concerned, a secondary means of exit from projection rooms is now part of the Underwriters' code, is a feature of the S. M. P. E. standard room layouts, and is insisted upon by most progressive states and municipalities, and in Canada. These new regulations apply not only to a secondary means of exit but also to approved plumbing and ventilation within the room.

Evidence of the effectiveness of these regulations is supplied by M. D. O'Brien of the Loew's Theatres Projection Dept. Desiring to enlarge an existing room by some four feet in length, Mr. O'Brien was surprised to learn that he must go all the way and provide a second exit therefrom, install plumbing and improve the ventilation. Moreover, if the second exit should be to the roof, the new regulations demand that means be provided for descent from the roof to the ground, or for passage to an adjoining building. Many rooms of recent construction display this latter feature.

Unfortunately, these new regulations apply only to *new construction or alteration;* existing old-type rooms are not affected thereby. Had Mr. O'Brien decided not to enlarge this particular room, no changes whatever would have been required. It is apparent that in this respect the San Francisco ruling cited by Mr. Woods is unusually inclusive, that is, with respect to the great difficulty certain to be encountered by many old theatres in providing another exit. However, I. P. can only applaud this ruling, despite its inclusiveness.

Real Significance Hidden

Mr. Woods' letter is vastly more significant than he possibly thought when he penned it, transcending in importance the question of a secondary room exit. He suggests, for example, that a "concerted" effort be made to direct the attention of regulatory bodies, and that of the S.M.P.E., to the necessity for such rulings. Concerted action by whom? By the national organization of projectionists? Certainly not, because the organization has never made any move toward, nor displayed the slightest interest in, the setting up of such a legislative group. True, units of the organization participate in various sectional legislative bodies, but these groups are loosely organized to cope with problems of the moment and invariably operate spasmodically and without any definite unity of action or purpose.

Why, these so-called legislative bodies come to I. P. for helpful data which should be available to them instantly from organization headquarters merely for the asking. Granted that this collecting and collating of data is a proper function of I. P., (and I. P. recognizes its responsibility to render such service) the fact remains that this publication has not been in existence long enough to gather records covering a sufficient time period as to be impressive or in any way exert any influence over any intelligent regulatory body.

I. P. has serviced more than 60 local or statewide groups within the past half

year. This service was cheerfully given in the hope that it would prove effective. But did it? We doubt it, for reasons so obvious as to require no comment. Sectional legislative work is a commendable enterprise, but its effectiveness is such as to command silence out of deference to organization pride.

After all, groups like the S. M. P. E. can merely *recommend;* they are in no sense of the term regulatory bodies possessing the power to enact legislation. Local and sectional "legislative committees," even if identified with a national organization, are equally powerless, we believe, to influence beneficial legislation, as is proven by the record of their accomplishments through the years. Legislation, it seems from this corner, is always predicated upon some particular disaster or series of regrettable incidents, builded not infrequently on a foundation of charred corpses, including projectionists. This opinion might be expanded to include not only fire hazards incident to projection work but also room ventilation, plumbing facilities and whatever else is necessary to insure the safety and comfort of the crew.

Why, we would make so bold as to recommend that this interest in working conditions in the field take in also all types of equipment, which should be carefully examined with an eye to the protection of he who is to operate it. Danger lurks not only in the room specifications but also in the equipment that goes into that room.

By Way of Comparison

Just to drive the needle a little deeper into the hides of some of our complacent craftsmen, whose chests have expanded pace with each of their "accomplishments" in behalf of craft welfare, may we ask if any reader of these lines believes—nay, even suspects—that any unit of the I. L. G. W. (just for example, of course) need flounder around and seek to get needed legislative data by word-of-mouth, or through stray newspaper clippings, or through dependence upon some publication already hard pressed to keep agoing a commercial proposition that is short-handed, does not possess adequate research and clerical help and must continually keep an eye on income and outgo? The answer to this innocent query is: Nonsense! The local unit merely shoots a wire to Washington; and back flies the *correct* answer extracted from files maintained for just this purpose and buttressed by data compiled by eminently qualified research workers.

The writer has participated in many legislative jousts, large and small, in many sections of the country; but he recalls not a single instance in which the craft representatives can be said to have benefitted through at least adequate representation. Why? Simply because they were not prepared: they didn't know their subject; they had been denied access to factual data in support of their contentions; they had not been guided in correct procedure by experienced legislative workers, and invariably they did more damage to the projection cause in general than they hoped to do good in a particular direction.

For ten years the writer has advocated the establishment of a research group—whether official or non-official doesn't matter so long as it is manned by those whose loyalty to and interest in craft advancement is unquestionable — to which the craft might turn for guidance not only in legislative matters but as a means for improving everyday working conditions. The words in all such articles and editorials penned by the writer since 1927, if laid end to end, would reach at least to China, and maybe back again; but thus far to no avail.

The reason for this seeming inactivity is quite apparent. In 1927 the introduction of sound pictures, with all its attendant confusion, stood the craft on its collective ear and had it gasping for breath in an effort to keep pace with the new and novel. Once straightened out on its course, the craft was hit by THAT THING in 1929 which gave rise to a situation wherein the craft fought a desperate battle not to advance itself but to survive. It is only within recent months that general economic conditions have permitted the craft to indulge in the luxury of an overcoat with which to cover its shivering frame, so to speak. Thus, maybe now is the time to revive this important topic.

The craft can expect no help in this direction from outside its own ranks. There exist not a few societies, local technical groups and other units which interest themselves in projection—that is, projection as a technical subject, as a means to an end, such as the improvement of sound picture reproduction, upon which the projection process exerts such an important influence. But there exists no society or organization which is interested in projection *per se*, or in the welfare or advancement of those who operate projection equipment; all of them are guided by ideals and aspirations which definitely can not be identified with those of the organized craft.

The Job Is Within

All of which leads to the crux of this statement: the observation that if the craft desires help in this respect it can expect aid only from within its own ranks. That such an activity is urgently needed and that it would return handsome dividends in the form of better wages and working conditions will not be doubted by any serious-minded craftsman. The failure to organize and further the work of such a group will mean a continuation of the present situation wherein sporadic legislative sallies by well-meaning but misguided local or sectional groups will not only fall short of their objectives but actually inflict severe penalties upon the craft at large.

Our apologies to Mr. Woods for building such a tall structure upon his rather frail-looking, but actually strong-ribbed, foundation; but in the next breath our thanks to him for providing the springboard from which we were able to take this plunge.

HOW PITCH CHANGES WITH LOUDNESS

By *A. R. SOFFEL*
Bell Telephone Laboratories

FEW people realize that the pitch of a sound changes with its loudness, although this auditory phenomenon has been recognized by some musicians. If two tones physically of the same frequency, which are sounded alternately, differ in their intensities, the ear may perceive them as of different pitch although the same number of waves reach it in each second. If the frequency is low and the difference in intensity is large, the tones may appear to differ in pitch by as much as an octave.

For quantitative study of this phenomenon a single tone is varied in intensity and its apparent pitch, corresponding to each intensity, is determined by comparison with a sine-wave reference tone of a constant and low-loudness level.* For each intensity of the tone under test a series of observations is required to determine the frequency of the reference tone which has the same apparent pitch.

Observers differ as to their observations; and the same observer may also arrive at contradictory judgments, particularly when the pitch of the test tone appears to him very near that of the reference tone. The test procedure, therefore, is to present for judgment pairs of tones formed by the tone under test and a reference tone of known frequency. The latter is varied through a range of frequencies; and its equal pitch value is taken as that for which in half the pairs it appears higher and in half lower.

Two different types of sound source were used in the tests: loudspeakers

* The loudness level of this tone is 40 db., where zero represents the threshold of audibility for an observer with very acute hearing, and 120 the point at which a sound starts to be "felt" rather than heard. Conversational speech when heard at a distance of 100 feet has a loudness level of approximately 40 db.

capable of producing very intense sound fields at low frequencies with very small harmonic distortion, and dynamic telephone receivers. Disturbing noise was eliminated by conducting the tests in soundproof rooms and by having the operator and equipment in a different room some distance away.

A crew of nine observers was used in most of the tests. After some preliminary trials a series of measurements was made using telephone receivers to determine the pitch of a 100-cycle pure tone at loudness levels of 40, 70 and 95 db. Four runs were taken successively with the crew of nine. These tests were made to show the consistency of an observer's judgments and to give practice at this type of balance. The observers' perception varied between wide limits from time to time and some observers perceived much greater changes in pitch with loudness than others.

Downward Shift of Pitch

Following this another series of tests was made using the loudspeaker as a sound source. Pure tones of three different frequencies, 75, 140, and 240 cycles, were tested in this series at loudness levels of 20, 40, 65, 85, 105 and 120. One observer perceived no change in pitch as the loudness of a tone was increased, and when a change was observed the pitch was lowered as the loudness increased. In this extreme case a shift of a whole octave was observed at 240 cycles; while at the same loudness level the other observer perceived no shift at all. However, the average of the result of nine observers shows a consistent downward shift of pitch for increased loudness.

For loudness levels below 110 there is a maximum of pitch shift in the neighborhood of 100 cycles. At the loudness level of 120, the region of maximum shift is just above 200 cycles. Beyond the maximum point the pitch shift decreases with frequency and becomes zero at 2000 cycles. Although no data have been taken at frequencies above 2000 cycles, there is reason to believe that the pitch increases with increased loudness at higher frequencies. Evidently, before a pitch can be assigned to a pure tone of low frequency, both its frequency and loudness must be known.

These observations were for pure tones. Most musical tones are complex and do not exhibit such startling changes in pitch with loudness. When a tone composed of five harmonic components (200, 400, 600, 800, 1000) of equal intensity was changed in loudness level from 40 to 114, a decrease in pitch of only two per cent was observed.

On the other hand, when a pure tone at a frequency of 200 cycles was carried through the same change in loudness level, its pitch was found to decrease eleven per cent. From this it might be considered that the perception of pitch for the complex tone described above was probably influenced to a considerably greater extent by the character of the several overtones involved than by the loudness itself.

A discussion of this aspect of the subject, however, is beyond the scope of the present article. The complete understanding of the workings of the human ear awaits further studies of this type on the complex reactions of hearing.

Projection Room Fire Precautions

It has been well said that people need not so much to be told as to be reminded. The recent series of projection room fires, with their accompanying toll in human lives and great property damage, calls for a restatement of those fundamental precautions against fire, known to all projectionists but so easily forgotten.

II

Projection rooms must be kept free of litter. Clothing and all other inflammable or combustible material must be kept in metal cabinets or lockers.

All exhaust fans and vents must receive regular inspection and necessary attention.

Fire extinguishers of the proper number and type to comply with local regulations must be conveniently located in the projection room, and must be periodically inspected, replenished and kept in condition for instant use.

Each item of projection must be electrically grounded, and all adjacent metal of the projection room must be similarly bonded to ground.

Over-fusing or overloading of circuits must be avoided. All wiring connections must be periodically checked for tightness and corrosion.

Lamp leads and other exposed wiring must be regularly inspected for defective insulation.

Rheostats, electric lamps and rectifier and amplifier tubes must be located or shielded so as to prevent film from making direct contact therewith. If it is necessary to place rheostats in the projection room, they should be located on a high shelf. Preferably, they should be located in a separate, well-ventilated room.

Film must be examined prior to first projection, repaired and placed on straight reels, which are retained exclusively for theatre use, and *a report should be made to the manager if the film is not in good condition.*

Film shall also be examined for loose splices, stripped sprocket holes and tears after each run,—and necessary repair made. Each splice made shall be checked for tightness and alignment of sprocket holes.

All film, including trailers, leaders and, particularly, scraps must be kept in proper containers.

Film must not be exposed on rewinder or elsewhere longer than required for threading or re-winding and making necessary repairs.

Threading of projectors must be rechecked before showing film.

Projectors must not be threaded while arc is burning. Arc must be "killed" before removing film from projector.

Hot carbons must be deposited in metal receptacle provided solely for this purpose. Hot carbons must not be handled near exposed film.

Smoking or reading while on duty or entertaining visitors in the projection room is, naturally, prohibited.

Phone Calls Distracting

Phone and personal calls to the projection room distract the attention of the projectionist and should therefore be restricted to the minimum.

Projectionist shall be constantly at the side of the projector while in operation, with his entire attention devoted to projection. His most important duty is to prevent fires rather than attempt to put them out.

If, in spite of all precautions, a fire develops, the first and foremost consideration is to prevent knowledge of this fact from reaching the audience and starting a panic. It is, therefore, most important to see that all port shutters close, (either automatically or manually), the instant the fire starts. Immediately afterwards the projector arc and motor switches should be opened and the exhaust fans started (if not already started by the shutter release cord). Efforts to limit the spread of the fire are next in order.

SUPPLY FIELD NOTES

CONVERSION of existing low-intensity Peerless lamps is provided for by a unit recently made available by J. E. McAuley Co., Chicago, makers of this lamp. The unit includes a complete reflector holder, for a 10¼" mirror, with a convenient crater indicator. A mirror, warranted to be optical correct, is included, along with a complete light cone and dowser and a positive and negative carbon holder. In ordering it is important to specify the size of negative carbon being used, so the proper holder may be included.

This unit is available through all National Theatre Supply branches. A circular may be had from the McAuley Co. at 554 West Adams Street, Chicago.

FREE TESTING MANUAL

For those who use or are interested in radio test instruments, the Supreme Instruments Corp., Greenwood, Miss., has published a manual of more than 60 pages entitled "Tube and Test Instrument Design Manual," which illustrates and describes the design of meters and circuits employed in the Supreme line. The manual includes some hitherto unpublished information on test instruments.

A complimentary copy will be sent upon request to all who identify themselves as readers of I. P. Address the company direct.

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

ORGANIZING activities of the "United Theatrical and Motion Picture Workers' Union," directed from N. Y. City and claiming the approval and backing of John L. Lewis and his C. I. O. group, sustained a severe jolt when Lewis issued a statement disclaiming any connection with the movement and protesting his very "friendly relations" with the I. A. T. S. E. The United is headed by Bernard Deckoff, who asserts that 60 locals have been formed throughout the country. His organization seeks to control all industry workers, excluding actual owners of theatres, which means a group comprising projectionists, stagehands, musicians, electricians, ushers, doormen, cashiers, porters, matrons, all studio employees, exchange workers and managers.

Deckoff, a licensed projectionist, apparently views the present muddled theatre labor situation in N. Y. City as a splendid opportunity for organizing work, his unit there being Local 1. Organizing outside N. Y. by the Deckoff group has been the topic of scattered reports.

Ten Best Films of 1936

The ten best films of 1936, according to the Film Daily annual poll of 500 critics throughout the country, are in the order named: Mutiny on the Bounty, Mr. Deeds Goes to Town, The Great Ziegfeld, San Francisco, Dodsworth, The Story of Louis Pasteur, A Tale of Two Cities, Anthony Adverse, The Green Pastures, and A Midsummer Night's Dream. Surprising was the widespread support accorded the so-called costume films, looked upon with disfavor by many exhibitors.

That Old Refrain

That same old story: Benjamin Tuttle stuck to his projection room post in the Tivoli Theatre, Omaha, and is credited with having averted a panic when smoke poured in from a fire next door. It happens that Tuttle was seriously burned in a film fire two years ago, and he explained that he was afraid of causing a panic in the present instance.

Erpi Course Charted By Phone Company Head

Concluding sessions of the Federal Communications Commission investigation into Erpi motion picture activities featured the testimony of President Walter S. Gifford of A. T. & T., parent body of Erpi. Statements of the telephone head confirmed in detail information published exclusively in I. P. in 1935.

Stating his belief that A. T. & T. should not be in any field but that of communications, Gifford revealed that plans laid in June, 1935, for the disposal of Erpi "ran up a blind alley" and stopped. Erpi long-term producer contracts provided the chief obstacle to a sale, he said. (I. P. reported in August, 1935, that Erpi had been offered to Atlas Corp., which had turned down the deal because of the huge total of contingent liabilities in the form of lawsuits, *etc.*) Gifford said that he would prefer another company to handle outside fields under A. T. & T. license. He added that he was "not sure that Erpi operations have not been more detrimental than helpful" to A. T. & T. public relations.

It was brought out through letters written by John E. Otterson, former Erpi head, that early in 1933 the film industry owed Erpi $16,000,000, which fact caused Erpi some concern because it felt that the industry was in a bad way and needed rebuilding. Moreover, an expected income of $65,000,000 during the next five years was at stake. The power to "reorganize" the industry rested with Chase National Bank and Erpi, the two largest interest holders in the business. This situation prompted Otterson to suggest to Chase that all producing, distributing and theatre operation be consolidated in one company.

Otterson was also credited with a plan whereby the operation of all the smaller theatres would be consolidated under one head, which idea was discussed with leading producers but got nowhere. This plan evidently was the origin of the inclusive servicing plan (just another term for management) introduced in 1935 by Erpi, which idea also got nowhere mainly because of the terrific opposition generated thereto by I. P., which was the only publication in the industry that even mentioned the topic, much less opposed it. The stiff-necked attitude of Labor, inspired by I. P. articles and editorials, served to put a quick quietus on this proposition.

Otterson concluded his testimony by saying that decentralized operation is preferable today in view of the improved economic status of the industry.

N. Y. State Bill Re: License and 1-Man Operation

Under provisions of a bill introduced in the N. Y. State Assembly, the general city law is amended, requiring persons in first-class cities threading up motion picture apparatus to have a license. The bill would permit practical experience in moving picture projection rooms in lieu of apprenticeship for obtaining such license and preventing revoking or suspension of license except for cause, also prohibiting the projectionist from leaving projection room while operating apparatus.

The latter provision, if adopted, would be in conflict with the long-term merger contract now being negotiated in N. Y. City, which permits one-man operation.

S.M.P.E. Reappoints H. Rubin

Harry Rubin, director of projection for Paramount Pictures, has been reappointed chairman of the Projection Practice Committee of the S. M. P. E. for the fifth time in six years. The complete committee roster will be announced soon.

L.U. 645 Elects '37 Officers

Officers elected at the last regular meeting of L. U. 645, Rockland County, N. Y., are: Joseph Gerson, pres.; Russell Matthews, v.-p.; K. H. Gerlach, Jr., fin. secy.; William J. Motto, rec. secy.; W. F. Moren, b.a., and W. F. O'Mahoney, chairman of trustees.

Bonuses for all Union Help

Appended letter is self-explanatory: "In your Dec., 1936, issue you state that Union employees were included in Christmas bonus distributed by J. L. & S. theatre circuit in Chicago. First time for Union help of this circuit, and one of the rare occasions anywhere. In fairness to Minnesota Amus. Co. (Paramount), this circuit gave bonuses to help, *including* Union men. In our town a Xmas party was held at which checks were distributed."—E. T. Towne, Sec., L. U. 525, Aberdeen, So. Dakota.

Various other circuit employees addressed I. P. on this topic, disclosing growing tendency on part of employers to include Union help as a matter of course.

N. Y. 'City Settlement'

Merger of N. Y. city projectionist groups—*i.e.*, I. A. Local 306, the Empire and Allied independent units—to settle the chaotic labor conditions existing there is expected shortly. Lacking official confirmation, it is understood that the "settlement" provides for scales of $93 *total room cost weekly* in houses under 600 seats; $131 for theatres up to 1,000 seats, and $168 for theatres over 1,000 seats.

Room crews will consist of three men, two steady men on an all-day grind, and one 2-day relief man, which plan will

mean official acceptance of one-man operation for short periods daily for the first time in the history of Local 306. Some 285 Allied men will be taken into L. U. 306 at $200 each, and about 25 unemployed men will be charged $500. The latter group demands preferential position on the 306 work list. All this will be incorporated in a ten-year contract, which in the case of many members means in perpetuity.

G. T. E. Loan Paid Off

General Theatres Equipment Corp., has paid off a $2,000,000 loan from the Chase National Bank made to finance the reorganization plan of the company. The loan, which was convertible into debentures and then into stock of the company, was paid off through funds obtained largely by sale of subscription warrants for capital stock of the company, Earl G. Hines, president of the company, announced.

Theatre Income Up Sharply

Major theatre circuit grosses are 15 to 25% higher than a year ago, according to word from company executives. Loew's reported a net profit of $3,457,973 for the 12-week period ended Nov. 19 last. RKO reports a 15% jump in income; while Warner has announced a 20% increase in receipts. Current flood and strike conditions are operating to whittle away a large portion of this increased revenue, with severe losses being registered on distributors' sheets.

International Standards Group

Following development of a world-wide standard for 16 mm. sound films providing for complete interchangeability of films and equipment, a committee representing all branches of the photographic industry has been set up to work out other national and international standards in the photographic field.

The committee includes L. A. Jones and Walter Clark of Eastman Kodak; Dr. Alfred N. Goldsmith, of the S. M. P. E.; V. S. Sease, DuPont Mfg. Co.; W. A. Schmidt, Agfa-Ansco Corp.; W. B. Rayton, Bausch & Lomb Co., and A. C. Hardy, Optical Society of America.

PROJECTION OF LENTICULAR COLOR FILM

(*Continued from page 22*)

probably no change in projector mechanism would be needed in order to get sufficient light.

Print Density.—Another loss of light occurring in the ordinary projector is caused by the minimum photographic density allowable in making the print. Because of the excellent tone reproduction attained with the lenticular process, it is possible to make the print density lower than that of a corresponding black-and-white print by approximately 0.10. This gives a 25 per cent increase in picture brightness.

Summary of the Gains Made.—It was pointed out in connection with the filters that the maximum filter transmission, combined with that of the lenticular support, was in the neighborhood of 17.6 per cent, which corresponds to a factor of 5.8. This is the factor by which the screen brightness must be increased in order to equal that of corresponding

black-and-white projection. The gains made and discussed above may be summarized as in Table I:

TABLE I

		Factor
(1)	Increased relative aperture (*f*/2.5 to *f*/1.6)	2.31*x*
(2)	Reduction of shutter loss 60°-40° shutter, 68° pull-down	1.44*x*
(3)	Lower print density by 0.10	1.25*x*
	Product of all the above gains	4.32*x*

This is somewhat short of the required 5.8 necessary to balance the filter loss. In addition to these gains, the authors are of the opinion that the screen illumination can be doubled if sufficient improvement can be made in the operating conditions of the arc and the optical system. The product of this and all the gain factors given above leaves ample margin for the projectionist in operating the projector when compared to the loss factor of 5.8 mentioned above.

The complete experimental projector was used to give two demonstrations in the Loew's Rochester Theatre in April, 1936. On both occasions the 52-degree accelerated pull-down was used. After the 68-degree pull-down was substituted, the machine was used to give a demonstration in the Center Theatre, N. Y., on July 9, 1936, before some 200 guests. Many of the audience commented upon the show, but no one expressed any feeling that there was a lack of screen brightness. Some actually said they believed the screen brightness was greater than necessary.

Although many measurements of screen illumination were made throughout all these experiments, a simple statement of the values in foot-candles attained would have little meaning in view of the conflicting reports already published both as to the screen brightness actually prevailing in theatres and as to the actual level of screen brightness that is to be desired. To give some indication, however, of the amount of light obtained on the screen of the Center Theatre, the value measured with a Weston illuminometer No. 603, without the color filters or lenticular film, but with the shutter running, was 33 foot-candles at the center of the screen. The screen picture was 22 feet wide, and the projection angle was 28 degrees. If the heat-absorbing glass filter had been removed, the value would have been more than 40 foot-candles.

Of course, every precaution was taken in both the demonstrations to assure optimal operating conditions. It is probably too much to hope that optical conditions could be thus maintained at all times. With this in mind, other possibilities will now be discussed, by means of which still more light might be obtained. If the regular high-intensity carbons were used, instead of the Suprex carbons, in connection with a reflector-lamp of most efficient design, there would be an increase due to the higher intrinsic brightness attained with the regular h.-i. carbons.

The possibilities that a new type of arc

source will be developed having still higher intrinsic brightness can not be excluded. In this connection, carbon manufacturers express the belief that developmental work now in progress will produce a carbon that, with the proper optical system and lamp mechanism, will give the desired intensity, color, and uniformity of light, and at the same time, keep the energy input into the arc within reasonable limits.

There are some improvements yet to be made in the present experimental optical system that will make it possible to eliminate some of the glass-air reflection losses. A desirable further improvement in the optical quality of commercial reflectors would reduce losses arising from the imperfect formation of the crater image at the film-gate. The belief has already been expressed that improvement in projector design could be made that would further reduce the shutter loss.

Reduction in Screen Size

Another consideration is the possibility of a slight reduction of the screen size. Even for black-and-white projection, a reduction of screen size is being advocated by some in the industry. It is difficult to find any objection to doing this, since, with the present sizes of screens there is always a large block of seats near the front of the theatre that the patrons avoid because of the discomforts of so large a viewing angle. There would seem to be no loss of desirable seating space by making conditions more comfortable for those in the front even at the expense of some loss in the rear of the house. Since the screen brightness would vary inversely as the square of the screen width, a considerable gain in illumination ought to be made possible by only a moderate reduction of screen size.

The use of the ordinary specular screens would, of course, be limited to the long narrow houses, in which the seats are distributed within an angle of some 20 degrees. The design of equipment to take care of the few large houses having exceptionally large screens must be considered as a separate problem.

Although not all possibilities have been utilized in this preliminary investigation of the problem, it is seen from the foregoing experiments that lenticular color-films can be projected satisfactorily in the average theatre without the necessity of making major alterations in the present equipment.

REFERENCE

[1] Cook, A. A.: "A Review of Projector and Screen Characteristics and their Effects upon Screen Brightness," *J. Soc. Mot. Pict. Eng.*, XXVI (May, 1936) No. 5, p. 522. (Also in I.P. for May, 1936, p. 17.)

DISCUSSION

MR. RICHARDSON: Is it not possible, by means of the additional lens, to parallel the light-beam between the aperture and the projection lens, and thus have more uniform screen illumination?

MR. MILLER: Arc lights do not radiate with equal intensity in all directions. Something could probably be done by using a shorter focal length reflector. Unfortunately none were available at the time, and we wanted to incorporate a minimum number of changes in the lamp.

MR. TASKER: The review room screens at Universal Studio are measured daily, in view of the fact that they vary considerably. We find that it is possible by daily readjustment of the arc to get such results as 16 foot-lamberts at the center, 14½ to 15 at the edges, measured horizontally across top and bottom. Within a day's time the lamp is out of adjustment, and may be off as much as 15 at the center, 15 on one side, and 11 on the other.

MR. KURLANDER: A ratio of 1½ to 1 from the center to the corners is considered excellent. That is about the limit one can get and still maintain good efficiency. It is comparatively easy to get evenness if one wants to sacrifice intensity.

For 16 years or more we have been trying to get even a 10 per cent increase in screen illumination. Mr. Miller has just told us how he obtained a 400 per cent increase. In view of some of the methods used to attain this 400 per cent increase, I should like to see it analyzed a bit more. The mechanical efficiency of the projector, over a period of 16 years, has been increased from about 4 per cent to 8 per cent—a 100 per cent increase over a period of 16 years. Here, overnight, we have another 400 per cent.

MR. MILLER: We got 2.3 times as much

light by increasing the relative aperture. It was a few per cent less than that when the aperture was increased from $f/2.5$, which is about what is used on the average now, to $f/1.6$. I purposely omitted discussing the optical principles, particularly because they were so well treated by A. A. Cook in the *Journal* of last May.

MR. McAULEY: What is the distance from the vertex of the mirror to the aperture? How much did you move up the projector?

MR. MILLER: The projector was moved up only very slightly. The distance from the vertex of the reflector to the lens was 28 inches; from there to the aperture was 5¼ inches, making a total of 33¼. I believe a distance of 34 inches is recommended by the lamp manufacturers.

MR. McAULEY: Was it necessary to change the reflector?

MR. MILLER: No.

MR. McAULEY: In order to get the increase of speed? It would seem that you would hardly fill the lens at a distance of 33 inches.

MR. MILLER: If the light-rays are drawn backward after passing through the auxiliary condenser, it seems from the aperture as if the mirror were bigger.

MR. BRENKERT: Did you say that with the same mirror that was furnished with the lamp, and by adding the collimating lens, you filled an $f/1.6$ lens?

MR. MILLER: Yes.

MR. BRENKERT: And obtained more light upon the screen than by using an $f/2.3$?

MR. MILLER: Yes.

MR. BRENKERT: How did you get more light out of the arc, through the aperture and from the mirror, without changing any mirror specifications?

MR. MILLER: The fact is that the spot upon the aperture plate in the regular machine is much larger than the aperture itself, due to imperfections in the optical system, and also to the fact that the lamp manufacturer is desirous of giving a broad tolerance to the projectionist for keeping his arc focused properly. The magnification of the lamp without the condenser was six times.

MR. BRENKERT: You reduced the size of the spot by means of the auxiliary condenser, and that is your sole mention of greater angle and more light.

MR. MILLER: Yes, but we could use a larger carbon and a little more current, and thus increase the size of the spot. We use an 8-mm. carbon; but I think a 10-mm. would be better.

MR. BRENKERT: What became of the illumination at the corners?

MR. MILLER: If a black-and-white film was projected, the corner illumination was not good; if a lenticular film, the corners were no worse than for the black-and-white, with normal projection as occurring in theatres.

U. OF F. PROJECTION SHORT COURSE A GREAT SUCCESS

(*Continued from page* 16)

sources of power supply. C. C. Dash, of Hertner Electric Co., gave the best lecture on generators that anybody in the class had ever heard, starting right from scratch at the point of manufacture. He demonstrated the latest Hertner low-voltage machine designed especially for Suprex arcs. Data was given on wiring, operation and upkeep, rheostats, trans-

formers, how to calculate voltage-drop, the honing of armatures, setting of brushes, *etc.* An elaborate handbook was given to each member of the class.

Next came J. K. Elderkin, manufacturer of Forest rectifiers, who gave a two-hour lecture on copper-oxide rectifiers, designed for Suprex arc operation. Complete details were given on manufacture, operation, efficiency, and length of life. A number of Forest units were being used by classmen, who up to this point had received little information on their correct operation. (*Ed.'s Note: What's the matter, do none of the classmen read I. P.?*) Mr. Elderkin answered all questions on rectifiers, transformers, wiring and electrical calculations. Many rectification problems were discussed. Tube rectifiers were also discussed. Wiring charts of Forest units were distributed.

The Burgert Supply Co. demonstrated a 16 mm. Victor sound-film projector, using a film which pictured sound waves as viewed through an oscilloscope, showing how sounds are produced in the throat and the muscular action of the vocal cords. The machine was used throughout the week. Messrs. C. L. Swinney and Harry Leighley, for RCA, did a fine job on old- and new-type sound heads, and explained in detail push-pull recording, amplifier action, high- and low-frequency horns, impedance, condenser action, acoustic materials, *etc.* The RCA oscilloscope was demonstrated.

Les Abbott discussed the latest model Motiograph projector, complete with its massive base and associated sound reproducer. He detailed projector manufacture, cited recent improvements and conveniences for the projectionist, and took down and reassembled both the projector and sound heads. Advanced methods of trouble-tracing were outlined, from projector head to stage horns. C. D. Porter of the Wil-Kin Supply Co. closed the meeting with a discussion of projection practice generally.

This just about covers the school's activities. I say "just about," because nothing set down here could convey a proper idea of the worth of this course. Men who have worked in projection rooms for 15 and 20 years discovered to their amazement how much there was to learn about the art, even to the correct application of Ohm's Law in various calculations. Those who attended these sessions are absolutely sold on its value, and they would attend future classes even if the same ground were covered.

School officials and members of the first class are now planning another course of two weeks duration to begin about March 1 next. Difficulties encountered and errors made in the first session

will be avoided, and a vastly better course is in the making. Invitations will go out shortly.

A word about expense. The course was given absolutely free of charge, classmen being required to pay only for their lodging and meals. Clean, modern cottages were furnished with three excellent meals daily at a cost of only one dollar a day! The entire cost of the course to the writer, for example, who lives 300 miles away in Miami, was $4.50 for round-trip transportation and $6.00 for meals and lodging for the six days. Arrangements were made in all Local Unions so that members attending the school were covered and thus would not lose their wages. Those who covered the jobs will be repaid by extra time off in future.

So there you are, and maybe you don't thing it's something. Any other state group that neglects an opportunity to have a similar course is passing up a wonderful bet.

THE EFFECT OF ELECTRIC SHOCK ON THE HEART

(*Continued from page* 11)

mic movement. As a consequence, the pumping action of the heart ceases and the failure of circulation results in an asphyxial death within a few minutes. The medical profession has long recognized that when this condition is set up in man it is very unlikely to cease naturally before death. The value of current just under the threshold for fibrillation may, therefore, be taken as the maximum current to which man may safely be subjected, since, regardless of rescue or after-treatment, death is liable to result from greater currents.

The experimental investigation described here was, for this reason, directed towards a determination of the variation of this threshold current with a number of factors which enter into the practical application of the results. A number of species of animals were included in the tests to establish the trend of the effects with variation in physiological and morphological factors, but most of the experiments were upon animals comparable in body weight and in heart rate and weight to man, so that the results which were obtained would be indicative of what might be expected in man.

The animals were kept under surgical anaesthesia during the tests and the behavior of their hearts was studied by making electrocardiograms of each animal before and after shock. These were recorded together with the shock current and voltage by a three-string oscillograph. An electrocardiogram is a graphical record of the time variation of the voltage which is always associated with the action of the heart.

The threshold currents required to cause fibrillation in seven different species of animals were determined under standard reference conditions which included the use of 60-cycle alter-

nating current for a duration of 3 seconds, with the electrodes on the right fore and left hind legs—conditions typifying those of many accidental shocks to man. The general results obtained in which the minimum fibrillating current is plotted as a function of the body weight of the different species, show that individuals depart widely from the general trend of these results. The average weight of an adult man is approximately 70 kilograms and these results on the whole indicate that currents in excess of 0.1 ampere at 60 cycles, from hand to foot, will be dangerous for shock durations of 3 seconds or more.

Current Path Important

Inasmuch as the path of the current through the body affects the proportions of current which reaches the heart, the current path as determined by the points of contact with an external circuit influences the amount of current necessary to cause fibrillation. Based upon the animal tests, it is concluded that for man, pathways from arm to leg, across the chest, chest to arm and head to leg, may be expected to give about the same threshold.

The pathway between the arms should give a somewhat higher threshold, and from leg to leg the proportion of current reaching the heart is so small that fibrillation is not liable to result, even at currents of 15 amperes or more. Such currents would, however, probably burn or otherwise injure the victim, unless the contacts were good and the shock of short duration.

For shocks which last a second or more, the threshold fibrillating current at 25 cycles is about 25 per cent higher than the 60-cycle value, and the direct current threshold about 5 times that at 60 cycles. This relation probably does not hold for shock durations of a small fraction of a second, in which case thresholds for these frequencies would be expected to approach one another.

For shocks whose duration might be limited by quick-acting circuit breakers or other protective devices to a small fraction of a second, it was expected that the effect would depend upon the phase of the cardiac cycle during the occurrence of the shock. Special circuits were developed to take advantage of the conspicuous differences among the electro-cardiac impulses of a single heart beat to initiate operations which controlled the application of the shock and the recording of the current, the voltage and the electrocardiogram.

Cardiac Cycle Important

The timing of the shock in relation to this reference point was regulated by an adjustable electrical delay circuit and the duration of the shock was controlled by another similar circuit. The feeble impulses of the heart itself were thus made to control the power switches which applied the shock. The oscillograph was started a few seconds before shock and operated continuously, recording the pre-shock electrocardiogram, oscillograms of shock current and voltage, and a post-shock electrocardiogram of sufficient duration to show the effect of the shock on the heart.

The exact time relation of the shock to the immediately preceding electrocardiac cycle can thus be determined, assuming only that the heart continued its normal beat for the fraction of a second between the disconnection of the cardiograph and the application of shock.

The action currents from the body muscles which persist after the powerful muscular contractions during the shock obscure to some extent all post-

shock electrocardiac records, making them appear to have high-frequency irregularities, but the post-shock portion of our graphs reveals the same typical sequence of prominent deflections which appear before shock, proving coordinate heart action.

Current and Shock Duration

As a result of giving over 1,000 such controlled shocks to sheep, it was discovered that in order to produce fibrillation, shocks of 0.1 second or less must occur during the partially relaxed period of the cardiac cycle, corresponding to the T-wave of the electrocardiogram. This sensitive phase of the cardiac cycle is about twenty per cent of the whole. Outside of it fibrillation cannot be produced, with extremely rare exceptions, by currents up to at least 15 amperes, which was about the limit of the tests which were carried out.

With the discovery of the sensitive phase of the heart cycle, the threshold current required to produce fibrillation for short-duration shocks was then determined. The threshold current varies inversely with shock duration, but not uniformly — being most sensitive to change as the duration approaches the time of one heart beat. For shocks of 0.1 second or less it is ten or more times the threshold for durations of one second or more—a fact of great importance in the development and application of protective devices and methods.

Shocks a third or more of the heart cycle in duration may cause fibrillation, even though they would not extend into the sensitive phase of the cycle if the heart continued its normal beat. The reason is probably the initiation of a premature heart beat which brings about a premature sensitive phase prior to the end of the shock.

The susceptibility of the heart to fibrillation by short shocks increases with current up to several times the threshold as might be expected, but then the liability of fibrillation, strange as it may seem at first sight, diminishes and becomes very small for currents of the order of 25 amperes through the body in the vicinity of the heart. However, other serious injury may be expected from such currents when brought about by accidental contacts.

More surprising even than the fact that high currents are less prone to produce fibrillation than low currents, is the fact that fibrillation once caused by a relatively low-current shock can be arrested and the heart action brought back to normal by a subsequent electric shock of high intensity and short duration through the heart. This seems to be a rather striking and true example of the old adage that "The hair of the dog is good for the bite."

In the experimental study of the threshold conditions which bring about fibrillation, this normally fatal effect was necessarily the end result of most of the tests and an opportunity was thus afforded to investigate the effect of this so-called countershock method of restoring heart action. The method was first reported by the physiologists Prevost and Battelli, who worked at the University of Geneva in 1899 on dogs and smaller animals. In the investigation reported here, the method was successfully applied not only to dogs, but to sheep, hogs and calves.

Value of Countershock

To be successful, a countershock must be administered promptly after the fibrillating shock, probably within a few minutes. The need for maintaining respiration by artficial means is in no way lessened. In fact, the administration of artificial respiration even in the interval before the application of a countershock is highly advisable, not only for respiration itself, but because of the accompanying slight circulation which will assist in the nutrition of the heart and delay the degeneration of the brain.

Because our experiments using an arbitrarily chosen countershock on animals comparable in size to man showed a successful restoration in about sixty per cent of the cases, we can conclude that the method of countershock has distinct possibilities of successful application to man. The optimum conditions of countershock and practical apparatus and techniques for its application are matters which can only be determined by further work.

Simplex PROJECTORS — DISTRIBUTED BY NATIONAL THEATRE SUPPLY COMPANY

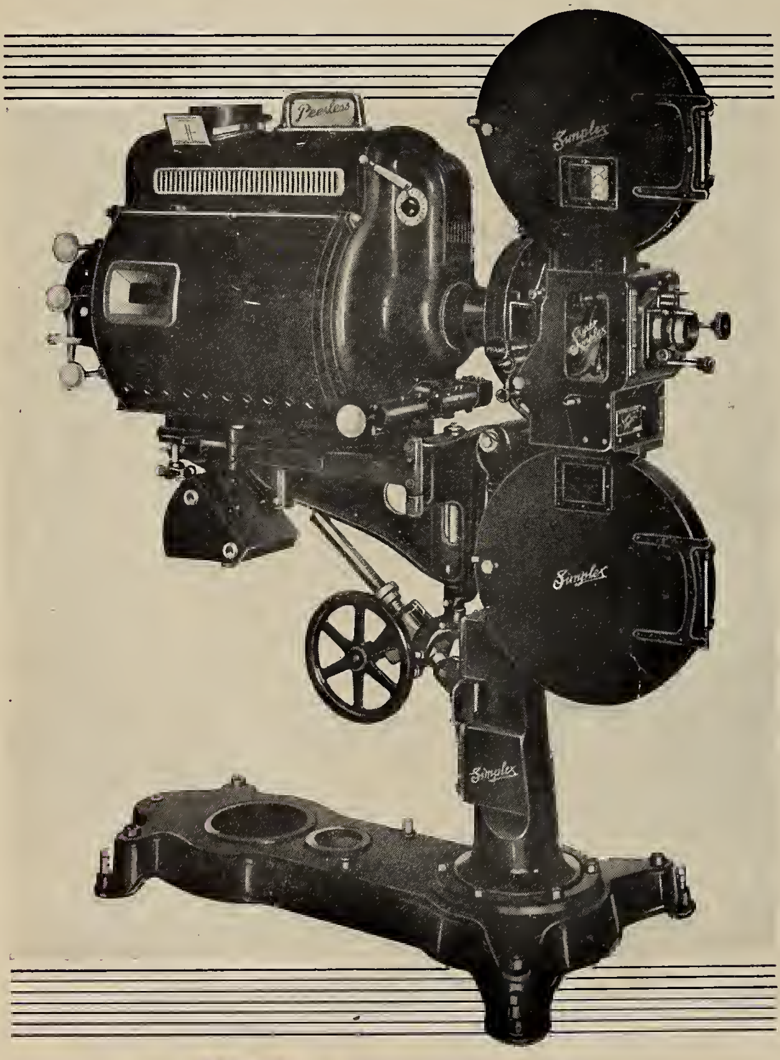
THE MANUFACTURERS OF Simplex PROJECTORS or ANY OF OUR DISTRIBUTORS WILL BE GLAD TO TELL YOU WHY

TRADE MARK REG'D

Super Simplex PROJECTORS

TRADE MARK REG'D

ARE USED in the FOLLOWING DE LUXE THEATRES



EMPIRE—LONDON.

ALAMEDA—MEXICO CITY

NIPPON—TOKYO,

METRO—JOHANNESBURG,

MARIGNAN-PATHE—PARIS

PARAMOUNT—NEW YORK,

RADIO CITY—NEW YORK,

LOS ANGELES—LOS ANGELES

— AND —

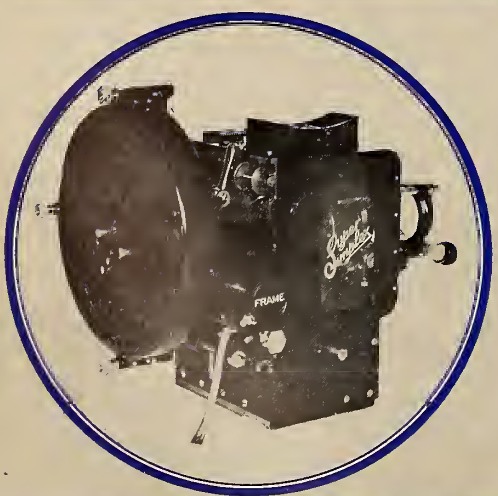
thousands of motion picture houses throughout the world in which the box office value of good projection is recognized.

BETTER PROJECTION PAYS.

Write to us or any of our distributors for full information regarding our products and let us explain why

Simplex PROJECTORS

ARE INTERNATIONALLY SUPREME



Super Simplex MECHANISM

Many theatres who are not ready at this time to purchase complete SUPER SIMPLEX PROJECTORS have found that the SUPER SIMPLEX MECHANISM at the new low price enables them to greatly improve projection at a very reasonable cost. In addition SUPER SIMPLEX MECHANISM also reduces repair and replacement charges and will pay for itself over and over again during the long period this equipment can be used.

Write to us or any of our distributors regarding price and many advantages of the Super Simplex Mechanism which include Hardened Intermittent, Heavy Main Frame, Burnished Bearings, Hardened Shafts, Built In Rear Shutter, Substantial Lens Mount, Heavy Cast Iron Film Trap, Removable Gate, Heavy and Larger Enclosing Covers.

· INTERNATIONAL PROJECTOR CORPORATION

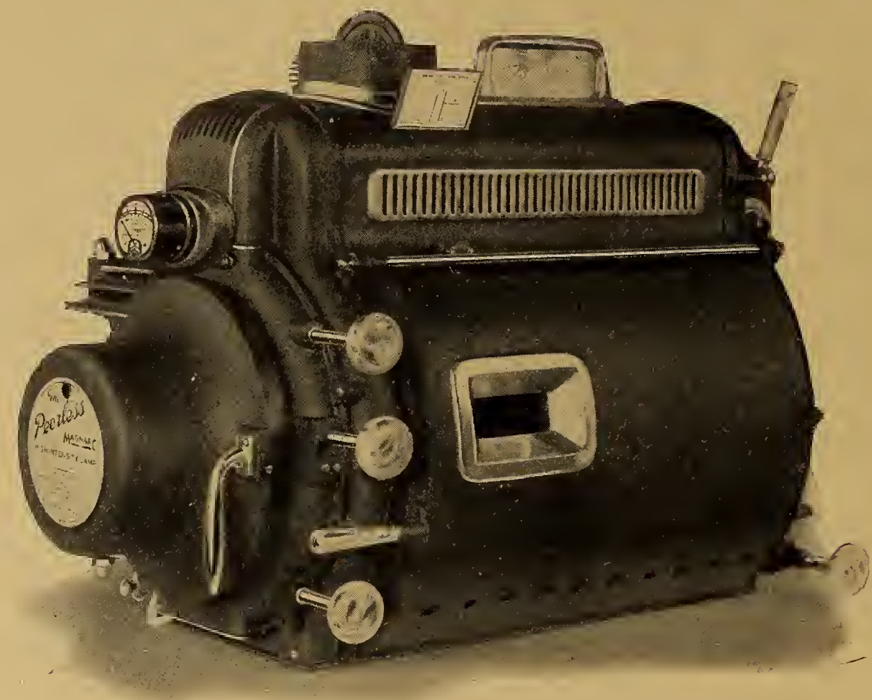
Ip

International PROJECTIONIST

FEBRUARY 1937 Vol. 12, No. 2

25c Copy $2 a year

PERMANENT SUPREMACY



Peerless MAGNARC

TRADE MARK REG.

The ideal back of this company's product has ever been—"That no finer product must be available to the user."

In consequence of this, no comparable example of engineering skill and precision workmanship exists.

The supremacy of PEERLESS MAGNARC is unique.

Incomparable are its many features, continuous perfect performance, extremely low maintenance cost and the tremendous volume of light it produces is truly phenomenal.

THAT IS WHY THERE ARE MORE PEERLESS MAGNARC LAMPS IN USE THAN THE COMBINED TOTAL OF ALL OTHER MAKES

SOLD BY

NATIONAL THEATRE SUPPLY CO.

MANUFACTURED BY

J. E. McAULEY MFG. CO.

552-554 W. ADAMS ST. CHICAGO, ILL., U. S. A.

THE WORLD'S LARGEST PRODUCER OF PROJECTOR ARC LAMPS

International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 12 FEBRUARY 1937 *Number 2*

Published Monthly by

JAMES J. FINN PUBLISHING CORPORATION

580 FIFTH AVENUE, NEW YORK, N. Y.

Circulation Manager, RUTH ENTRACHT

SUBSCRIPTION REPRESENTATIVES

AUSTRALIA: McGills, 183 Elizabeth St., Melbourne
NEW ZEALAND: Te Aro Book Depot, Ltd., 64 Courtenay Place Wellington
ENGLAND AND DOMINIONS: Wm. Dawson & Sons, Ltd., Pilgrim St., London, E. C. 4.

YEARLY SUBSCRIPTION: United States and possessions, $2 (two years, $3); Canada and foreign countries, $2.50. Single copies, 25 cents. Changes of address should be submitted two weeks in advance of publication date to insure receipt of current issue. Entered as second-class matter February 8, 1932, at the Post Office at New York, N. Y. under the act of March 3, 1879.

420

MONTHLY CHAT

HEREIN is the second in the series of amplifier and rectifier tube characteristics, together with socket connections—this time applying to Western Electric (Erpi) theatre sound picture equipments. This, together with the RCA tube characteristics published in I. P. for Dec., 1936, should service a majority of the craft in this particular respect.

Save these tube charts, the compilation of which reflects no little effort. Keep them handy in the projection room for constant ready reference. Duplicates of the RCA chart, which may have been mislain, will be supplied providing request is accompanied by three cents postage. Requests from organization officials for sufficient charts for entire memberships will be honored on the same basis.

Publication of these charts reflect a definite need expressed by many craft members, illustrating once more the responsiveness of I. P. to craft needs and the good that can be accomplished by closer contact between I. P. and the field—through correspondence. Don't hesitate to request I. P. service on any matter of this character. Incidentally, these tube charts are an exclusive feature of I.P., having been published nowhere else.

I. P. is sneeringly referred to in some quarters as a "crusading sheet"—which description is all right with us. There is so much that is rotten in this end of the business, including disdain if not actual contempt of the allegedly low-brow projectionist, that I. P. gets a great kick of straightening out a few of the vocal high-brows.

Next month, in addition to much other good stuff, we shall uncover the results of a little research into the functioning (if any) of the so-called new double-reel standard, including a few choice statistics about exchange operation and other activities incidental to a reel length that has strangely shrunk from an irreducible minimum of 1750 feet to 1000 feet and less. This task really galls us, because we shall have to use that time-worn phrase, "We told you so".

THE second instalment of the color cinematography article herein, to appear next month, will take the wraps off the current color film situation. As forecast in informed quarters, the real worry of the color promoters is the projection process. One color system, that of lenticular film, requires extensive overhauling of the projection plant, particularly anent optics. I. P. disapproves strongly of all this pulling and hauling of existing apparatus; it holds that a new system designed expressly for color projection is badly needed. More anon on this, after the "experts" have had their say.

The fact that straight black-and-white projection is wholly unsatisfactory in about 60% of American theatres seems not to deter even slightly the onward rush of color films. We shall see.

INTERNATIONAL PROJECTIONIST

VOLUME XII NUMBER 2

FEBRUARY 1937

TYPES OF SHUTTERS AND THEIR EFFECT UPON PROJECTION

By *A. C. SCHROEDER*

MEMBER, PROJECTIONIST LOCAL UNION 150, LOS ANGELES, CALIFORNIA

II

THE big advance was made when the shutter was put in front of the lens. This allowed the use of larger shutters. The two-blade idea was dropped, and we went to the three-blade type, which gave a practically flickerless picture; further, the large diameter gave the blades a higher speed (in feet, not revolutions, per minute), thus completing cut-off of the light in a correspondingly shorter time. This type was more efficient than the older one; but somewhat offsetting the higher peripheral speed is the fact that the light beam was larger in front of the lens than it was at the aperture, under certain conditions, so that some of the gain was often lost.

Baird then produced a two-blade outside shutter, but revolved it at a speed one and one-half times normal, or one and one-half complete revolutions for each picture frame, the same as the more conventional three-blade type; but the blades were traveling 50% faster, thus reducing the time required to cut off the light.

With this construction there was no master blade; or one might say that both blades were master blades. One blade cut off the light while one frame was pulled down; and the other blade did so for the next frame, the shutter interrupting the light twice between each movement of the film, or three times for each frame. This necessitated making both blades of the same width, and resulted in a shutter that probably did not allow any more light to reach the screen than did the three-blade type. This was so because the two flicker blades of the three-blade type were always somewhat smaller than the main blade, and, as mentioned previously, this was not possible with the Baird construction.

The Edison Outside Shutter

Baird did achieve a more nearly flickerless picture, however, because the unbalanced three-blade type introduced some flicker sixteen times a second, due to the wider master blade. About that time the normal speed of projection was increasing, and was soon around seventy feet per minute, rather than sixty, so the flicker was correspondingly less.

When Edison introduced his outside shutter, the shutter shaft was directly below the lens, and the shutter still moved up and down with the mechanism during framing. Due to its position *below* the lens, the effect shown in Figs. 1 and 2 (Jan. issue) was not present, which is readily evident if the machine is turned so that the edge of one of the blades is vertical. It will then cover

Erratum

An error occurred in the January issue instalment of this shutter article. On page 8 thereof, the sentence beginning 18 lines from the bottom of column 3 (exclusive of subhead), should have read:

"Notice that the angle between line A and dotted line C (in Fig. 3) is practically the same as the angle between *A and C* in Fig. 2, so we have gained practically nothing." The italicized phrase in the foregoing indicates the error.

exactly one-half the lens, and in framing up or down it still will cover exactly one-half the lens.

When the picture is framed down, however, the shutter shaft is raised and is then ¾ of an inch closer to the lens than when the picture is framed up as far as possible. This has the same effect as though the shutter diameter was reduced when the framer is in the down position, and the efficiency is correspondingly reduced. As a result of this, the efficiency was reduced even when the framer was at the opposite extreme. This could have been improved by so "angling" the edges of the blades that they would be narrower at the larger diameter than in the actual construction, thus allowing a greater percentage of light to pass as the picture was framed up. Fig. 7 conveys the idea, the dotted lines showing the outline of the blade as

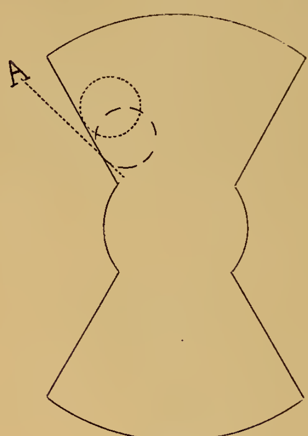


FIGURE 8

it actually was, and the solid lines the "angled" edges.

By placing the shutter in the position shown in Fig. 8, it will be easier to understand. Here one edge of the shutter is vertical. The dashed circle represents the light beam when the picture is framed down, and the shutter is up as close to the lens as possible. Notice that the edge of the blade is just even with the edge of the light beam; it just completely cuts off the light. When the picture is framed up, the shutter moves down, away from the light, and the beam will then hit the shutter where the dotted circle has been drawn. The edge of the shutter blade is still even with the edge of the light beam at this position.

The dotted line, A, (Fig. 8) shows where the edge of the blade would be in the shutter as it was actually constructed. It is even with the dashed circle; but notice that it has gone past the position where it would have cut off the light for the dotted circle, showing that light has been wasted for this position of the framer. A similar amount of light is lost as the shutter begins to

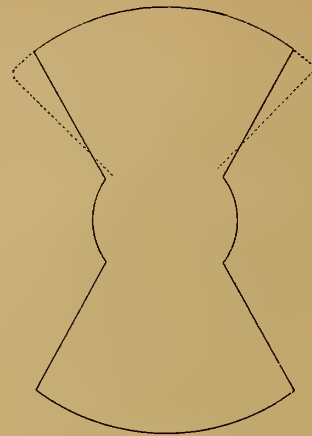


FIGURE 7

leave the light at the other edge of the blade.

The extent of this saving would vary under different conditions, and either was not thought of at the time or was not considered worth while. Obviously, where the shutter did not move as the picture was framed, there was no advantage in this idea, so this would not apply to the Powers, Simplex, *etc.*

Projection Speed a Factor

Even before sound pictures, projection speed had been slowly but steadily increasing, so that nearly everyone dropped the three-blade shutter and used the two-blade type, because it allowed more light to get to the picture. At first there was a trifle more flicker, but as the speed increased this became less and less, so that we actually have less flicker at 90 feet per minute, using the two-blade shutter, than we did at 60 feet with the three-blade type. The latter was always unbalanced: the master blade was wider than the other two. Had the blades been the same size, the flicker would have been less, but this cut down the light, which was undesirable.

A. C. Arc Requirements

With an a.c. arc the two-blade shutter had to be used (at 60 feet per minute), because the three blades synchronized with the alternations of the current, and violent flashing resulted. The writer was working "out in the sticks" in 1916 and the supply was through an old Forma-stat. The picture was very good when run at normal speed; but usually the last show was speeded up, inducing severe flashing, which limited the speed very much.

After considerable experimenting, a number of shutters were evolved, which approximated Fig. 9. Many shutters were made, differing only in some small detail, yet there was a world of difference in the results, the goal idea to get some light through even when the speed was such that the pulses of light came when parts A, B, and C were before the lens. On the other hand, when the light pulses came during the time that A, B, and C were *not* before the lens, projections D and E cut off enough light so that the picture would not brighten up too much.

Figure 9 probably does not reflect the ultimate possibilities of this idea, but it did permit a considerable increase of speed over the conventional shutter.

With the intense heat that accompanies the use of the newer lamps, it is suicidal to use the old-style front

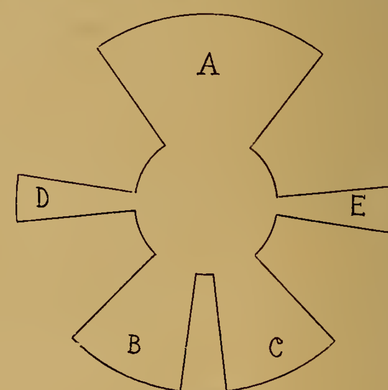


FIGURE 9

shutter; but it seems that hundreds of houses are either unaware of the danger or do not care.

With the shutter in this new position it would seem that all our desires had been met; we have a shutter of large diameter, giving a rapid cut-off of the light due to its high speed. It *apparently* cuts the light where it effectively has a narrow beam, and the edges of the blades seem to be quite nearly parallel to the upper and lower margins of the effective beam when the shutter enters and leaves it.

In Fig. 10 we see the upper margin of the *effective* light beam, starting at the top of the condenser and continuing on to the top edge of the aperture hole, A. A similar line shows the lower margin of the beam. The vertical line, S,

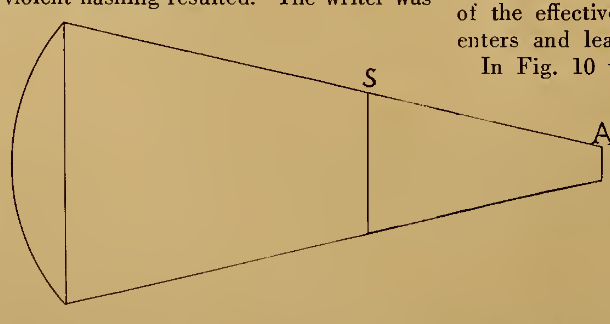


FIGURE 10

RCA PHOTOPHONE "THE MAGIC VOICE OF THE SCREEN"

New RCA Cellular Speakers are the final link in creating perfect sound reproduction!

There's something *new* in motion picture sound! It's a new voice—the Magic Voice of the Screen! And it belongs to RCA Photophone equipment!

The Magic Voice of the Screen is the name for RCA's newest complete high fidelity sound system including Cellular Speakers. RCA Cellular Speakers are the final link in the chain of perfect sound reproduction which Photophone has so progressively been forging for years.

Cellular Speakers! The famous Rotary Stabilizer! High Fidelity Amplifiers!—All these make RCA Photophone the outstanding leader in its field. And these features mean bigger box office for you. That's why we urge you to join the sweeping trend to Photophone. Give *your* screen this great Magic Voice. Let it *prove* its magnetic pulling power at your box office!

RCA presents the Metropolitan Opera every Saturday afternoon. And "Magic Key of RCA" every Sunday 2 to 3 P. M., E.S.T. Both on NBC Blue Network.

There's magic in the name

"MAGIC VOICE"

that will sing you a song of profit!

Millions of Americans are familiar with the Magic Voice of RCA Victor radios. And, when you own this new Photophone equipment, you can advertise "The Magic Voice of the Screen—an RCA product"—and profit by the widespread knowledge of the Magic Voice name and by RCA's reputation. The radio Magic Voice represents the highest standard of tonal quality in the home. The Magic Voice of the Screen attains that same lofty peak in the theatre!

What the new RCA Cellular Speakers mean to you

1 They are the first speakers to distribute all higher frequencies evenly throughout the theatre.

2 They have tremendous power handling capacity.

3 They provide undistorted reproduction of all notes—lowest to highest.

4 They require less room backstage.

RCA Photophone

RCA MANUFACTURING CO., INC., CAMDEN, N. J. • *A Service of the Radio Corporation of America*

shows the size of the beam where the shutter cuts across it. Not nearly as small as one would imagine at first. This is larger than the beam intercepted in front of the lens when the shutter is placed there. Is our rear shutter large enough to overcome this handicap? Hardly.

The effective beam of light where the shutter intercepts it is not square, nor is it a circle. The corners are rounded and the horizontal and vertical margins are not straight lines but are slightly curved. The condition shown in Fig. 3 (Jan. issue) is again present, except that the cross-section of the effective beam is slightly different, as just mentioned; it is larger, and, of course, the shutter is also larger.

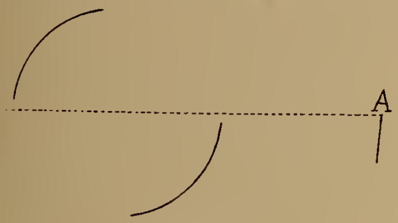


FIGURE 11

The condition is not quite as bad as it would appear from Fig. 3, mainly due to the change in the shape of the beam. If the corners were rounded, the line at A, Fig. 3, representing the edge of the blade, could be drawn in a slightly higher position, which means that the shutter would not enter the light until it had traveled farther in an upward direction, giving just that much more light. Also, the edge would then be more nearly parallel to the edge of the beam, another saving, as outlined last month.

The Motiograph-Type Shutter

Motiograph again has an advantage here, as they did before, because they cut the light from both the bottom and the top, thus effecting a complete cut-off of the light in one-half the time. Their shutter is smaller in diameter, however, which is not so good. Then, too, that portion of the shutter cutting the light closest to the arc is intercepting the ray where it is of much larger dimensions than it is closer to the aperture—another disadvantage.

In Fig. 11 we see the Motiograph shutter and its relation to the aperture, A. The shutter is represented as though we were looking at the ends of the blades, as if they had been sawed in half. The shutter on the machine actually looks like a cylinder that has had a portion of it cut away. In the drawing it looks as though the light had been cut off, considering that the blade at the right is moving up, and the left blade is going down.

The light has not been entirely cut off, however, as is shown by the dotted line. This line is coming from the lower portion of the condensers, or the mirror, as the case may be, and the entire upper half of the aperture is still covered with light. It is true that it is not fully illuminated, since all light from the upper half, and much of the light from the lower half, of the condenser has been cut off. The light will be completely stopped when the two blades reach the dotted line, although the first impression is that the shutter had accomplished this when in the position shown.

Large Light Beam Alternative

Figure 12 shows how we could overcome the trouble caused by the large light beam. L represents a negative lens, one that will take a converging light beam and change it so that the rays will be parallel after passing through the lens. S again represents the shutter. The size of the beam has been reduced at this point to the same dimensions it had at the aperture in Figs. 10 and 11 (the latter drawn to a larger scale than the others), either by moving the lamphouse back or by a change in the condenser combination.

Merely pulling the arc away from the condensers to reduce the size of the "spot" will not do, occasioning more loss of light, due to the inability of the rear condenser to collect the light, than will be gained by the use of the lens, L.

By this arrangement we now have the light beam of much smaller size, in the plane of the shutter—about the same size as it is at the aperture; and with our large shutter, we can trim the blades down a great deal and get a fairly large increase of light; but the effective beam is now the same shape as the aperture. Yes, there is some light loss due to the insertion of the additional lens, but not as much as would be gained.

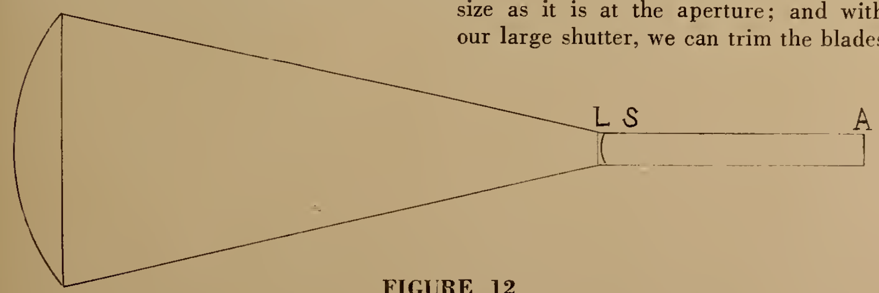


FIGURE 12

The thought comes to mind: why not reduce the light at L to a pin point, and then cause it to diverge enough so that it again fills the aperture? Then we would really have something! I wonder if a lens could be made to satisfy such a condition. Imagine the intensity of light and heat that would be concentrated at such a small point! which would also be the thinnest part of the lens, which must be comparatively thick at the edges in order to get the spread of light needed. Also, would the light spread so much that on the longer focal length lenses some of the beam would miss the rear surface of the projection lens? There are many puzzling problems in an idea such as this; it is something for the machine designer and the optician to work out. Possibly the advantages would not outweigh the disadvantages.

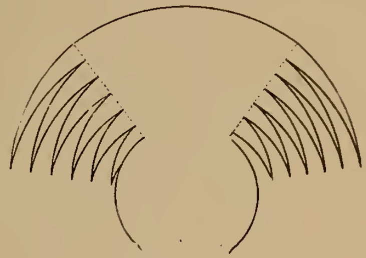


FIGURE 13

Particular Blade Shapes

One last thought, and that relative to the shape of the blades. Some projectionists assume that a blade of a particular shape is an advantage, that if the picture can be made to fade in and out it will much improve results. Many have tried to put sawteeth on the blades, like those on our old dissolvers. That this procedure would only cause additional light loss a little thought will show.

Remember, we must delay the time that the shutter enters the light until the last possible moment, and yet not so late that the light will not be cut off completely before the film starts to move appreciably.

This probably can be most easily shown by exaggerating the size of the sawteeth, as in Fig. 13. Here the teeth are shown curved, which they must be to remain in the beam, or normal travel of the shutter (due to their length in this instance) but this in no way affects the reasoning. Notice that the light is not cut off until the portion of the shutter shown by the dotted line has passed through the beam; but for some 45 degrees the sawteeth have been in the beam, causing a loss of 50% of the light available during that time. This light could have been used had the edge of the blade been straight and at the position of the dotted line.

WHAT IS THE PRESENT POSITION OF COLOR CINEMATOGRAPHY

By *D. A. SPENCER, Ph. D.*

The Presidential Address Before the Royal Photographic Society of England

What do you know about the requisites for and the results of the various color motion picture processes? About additive and subtractive systems? About the lenticular process now enjoying wide favor? About the projection of various colored films? About the economical, as well as the technical, aspects of the art today? These and many other questions are discussed in detail in the accompanying article by an acknowledged authority in the art This and the concluding instalment to be published next month should be retained as a valuable reference work on color cinematography.—*Editor.*

ARISTOTLE, looking at the rainbow, made the surprisingly accurate guess that there were only three so-called primary colors: red, green and blue, from which all other color could be synthesized. In the middle of the last century Wunsch demonstrated experimentally that this guess had been inspired, and long before the photographic emulsion was fitted for the task men were attempting to use it to record the colors of Nature by applying Wunsch's discovery in various ways.

(A color cartoon, showing the analysis of light proceeding from a multi-color object into its red, green and blue components by means of color filters placed in turn in front of the camera lens, and subsequent projection of the positives made from these negatives in a triple lantern, was projected.)

In the cartoon the three primary colored lights from which the picture is built up reach the eye simultaneously after reflection from the white screen. It is not, however, necessary that their arrival should be simultaneous for the same sensation to be aroused in our minds. We have in the lantern projector a glass disc with red, green and blue sectors situated behind a mask with a V-shaped slot. As the disc is slowly turned the image of this V on the screen appears alternately red, green and blue. If, however, the disc is spun at considerable speed, the individual primary colors are no longer distinguishable—the image on the screen appearing to be white. Similarly, when a second disc, consisting of red and green segments, is rapidly rotated behind the slot, we experience the sensation known as yellow and so on.

Successive Additive Projection

The earliest attempts at color cinematography were based on this observation (1897). In front of the camera lens is fitted a rotating filter with red, green and blue segments, and so geared with the mechanism that each neighboring frame on the film is exposed through a neighboring color filter. A black-and-white positive print from this negative is then projected through a similar segmented filter. The red filter positive image is in the gate when the red segment is in front of the projection lens, and so on, and the eye synthesizes the successive primary colored images.

Such a system was found of no value in practice, because any detectable movement in the subject photographed during the period required for the exposure of three successive frames, was rendered as an intolerable color fringe around the moving object, since only when the images on three successive frames are identical in shape will they register on the retina.

In an attempt to minimize this drawback, the negative has been exposed and the print subsequently projected at up to three times the normal speed. This expedient, although it reduces the difference in position of moving bodies as recorded by successive frames, does not eliminate it, and the normal observer is more intolerant of detectable color fringes, however small, than of quite gross errors in color rendering (flesh tints excepted).

Some of the difficulties of successive additive projection can be minimized by dividing the spectrum into two, rather than three, parts and attempting to match natural colors by using varying proportions of these two colors. One can either abandon the blue record entirely, or, by using a blue-green taking filter. record the blue and green rays on the same frame. Whichever method is adopted in taking, the projection filters must be complementary in color if a pure white is to be obtainable, and when this is the case, the color rendering is limited to two dominant hues, namely, those of the filter themselves.

Although two-color additive processes can give attractive pictures of carefully chosen subjects, the color rendering is not "natural," and this type of process need not be further considered.

Accordingly, attempts were made to record all three images simultaneously on neighboring frames of the film by means of three lens cameras, the positive film being subsequently projected in a three-lens projector. In 1912 Gaumont Co. demonstrated an additive three-color system of this type; but although the color rendering was excellent, their daily projections emphasized another serious difficulty. In the Gaumont camera the three separate lenses behaved as do the lenses on a stereoscopic camera, in that they recorded slightly different views of the subject, and fringing due to time parallax was replaced by fringing due to stereoparallax.

Unique Corrective Method

In order to render this fringing as unnoticeable as possible, an observer was stationed in the prompter's box, only a few feet away from the screen, and it was his duty to keep the principal object in each scene in register by operating electro-magnetic controls which gave vertical or transverse movements to the lenses as required during projection. In the hope of escaping this nightly drudgery, the operator constructed apparatus which registered the nature and extent of the corrections he was obliged to make throughout the showing and which would correct automatically at subsequent performances.

Unfortunately, however, in that each primary colored filter is absorbing at least two-thirds of the light falling on it, in order to obtain an adequately lit picture it was necessary to use a much more powerful arc lamp than was required for black-and-white, and the film shrank appreciably each time it passed through the exceedingly hot gate. As a result, the corrections given by this device only sufficed for one further showing.

Since that early and very striking demonstration, many methods have been proposed for overcoming errors due to stereoparallax, though most of them merely substituted other drawbacks; the images were freed from stereoparallax, but were of slightly different sizes, or the optical system was only capable of giving sharp focus over a limited depth

of field. None of these difficulties is incurable, however.

In the Francita Realita process, developed in France, a triple lens unit is used to record simultaneously the three separation images within the area of a single frame, each image being 8.5 x 11 mm. in size. Prisms in front of the lenses fitted with green and red filters are used to ensure that the view recorded through these lenses is identical with that which passes through the blue filter lens. Standard panchromatic film is used, and it is developed and printed exactly as for black-and-white.

The projection lens unit consists of three small fixed lenses fitted with appropriate filters and in front of which is a long-focus, large diameter lens which can be racked backwards and forwards to alter the equivalent focus of the combination and so correct any faulty superimposition of the images which might arise from film shrinkage. The projection lens has a second adjustment for azimuth, which is set and locked when the projection unit is first installed on any particular projector.

The Francita process is a direct descendant from the original chromoscope, but Du Hauron had also indicated a method whereby one could avoid the optical problems involved in the photographing and superimposition of three separate images. He suggested that the three-part images might be recorded on one plate through color filters of microscopic size intermingled in close juxtaposition—the so-called mosaic screen processes. The only professional process of this type is Dufaycolor.

The 16 mm. cartoon film demonstrated here was processed by the so-called reversal system, whereby the camera exposure is converted into a positive for projection. This is very suitable for the amateur, since, when only one copy is required, there is appreciable economy in producing this from the original negative.

For 35 mm. however, copies are essential and the reversal system has then many disadvantages. 35 mm. Dufaycolor is now processed by conventional negative-positive procedure, and the surprising improvement so obtained illustrates the contention that, while color is in the melting pot, it is unsafe to assess the future of any process on the basis of present drawbacks.

In its successive reversal form, Dufaycolor was open to criticism on several grounds which appeared to have no relation to the method used for processing and the results obtained by the new negative-positive technique have in some respects surprised even those who have been closely associated with it. Screen pattern is no longer troublesome, the impression that the whole screen was alive with ants having disappeared. At the same time photographic quality is enhanced, color rendering is more truthful, and the screen pattern is much less obtrusive.

Thirty-five mm. Dufaycolor, exposed in any standard camera, is developed to a negative by black-and-white technique, but using a special developer which has been found to prevent the degradation of color rendering which hitherto accompanied negative-positive processing of such material. The negative is contact-printed by means of light in which all rays capable of passing through mosaic elements of more than one color are absent.

The particular form of light used is more efficient than would be the so-called "analysis" filters commonly used when duplicating mosaic screen material. The gate of the printer contains an ingenious but simple device which, without sacrifice of definition, eliminates all risk of moire patterns caused by screen collision. The exposed positive is developed in a developer similar to that used for the negative and is projected, both as regards sight and sound, exactly as for black-and-white.

The Lenticular Film Process

The lenticular system[1] was foreshadowed by Liesegang, who suggested that colored diaphragms be used in front of the camera lens in conjunction with a cross-line screen. Each aperture in the latter acts as a pinhole camera reproducing the diaphragm aperture and, as a result, the half-tone negative so obtained is a composite three-color record of the object photographed. A lens diaphragm with three apertures fitted with red, green and blue-violet filters is used in conjunction with a support for a panchromatic emulsion bearing on the side nearest the lens a multitude of microscopic lenses formed by embossing the celluloid base.

Keller Dorian patented numerous methods of making appropriately embossed material. In 1928, Eastman Kodak Co. acquired the 16 mm. rights to this process and marketed as Kodacolor a reversible 16 mm. lenticular film. Kodacolor film base is embossed with cylindrical lenses—20 to the mm.—each of which is of such focal length that it focuses upon the emulsion beneath it an image of a linear tricolor filter fitted in front of the camera lens and with its filter segments parallel to the ridges on the film. The result obtained is, in effect, similar to that obtained by the use of a tricolor line screen mosaic with the filter units in contact with the emulsion.

Using a three-band filter on the camera lens, the image beneath each tiny cylindrical lens is subdivided into three parts—each corresponding to one segment of the composite filter and formed only of light which has passed through that segment. Thus, red rays reflected from the object photographed can only reach the emulsion via the red segment of the filter, and are directed by the optical system into the same relative position behind each cylindrical lens. When the exposed emulsion is reversed to a positive silver image, this portion will be transparent in proportion as red light fell upon it; and when the resulting film is projected through a precisely similar optical system, white light from the projection lamp passing through these transparent portions can leave the system only via the red filter segment.

This suggests that the projection system should be optically an exact inversion of the camera system. In practice, of course, the projection lens will normally be of longer focal length than the taking lens, and the image is not necessarily enlarged up to life-size. It is, however, not difficult to arrange that the cone of light coming through the projector lens has exactly the same angle as the cone of light which entered the camera lens, and supplementary lenses can be employed in the projection system to place the images of the banded color filter at the right point in the optical system.

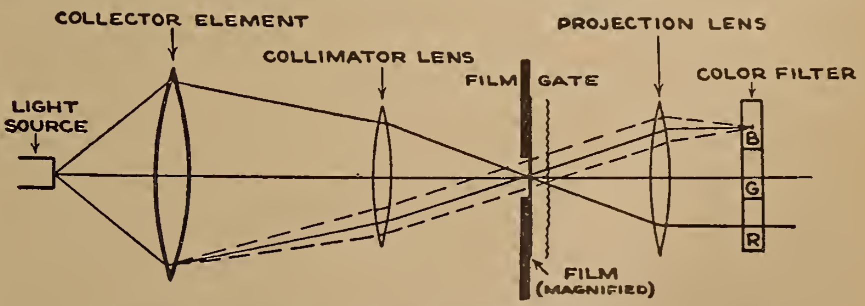


Diagram of projection optical system for lenticular color film

Agfacolor lenticular film is also available as 16 mm. stock—there being 36 lenticulations to the mm.

For some years intensive research in (*Continued on page* 31)

[1] Data on the projection of a modern lenticulated film color process were given in "Requisites For the Projection of Lenticular Color Film," in I. P. for Jan., 1937, p. 20.

COMMUTATORS: A LITTLE CARE SAVES BIG REPAIR BILLS

By *L. E. MILLER*

RELIANCE ELECTRIC ENGINEERING COMPANY, CLEVELAND

THE proper care of d.c. motor and generator commutators is a highly debateable subject. Nearly every maintenance engineer has his own pet methods which he is prepared to defend against all others. The following suggestions are put forward as the result of experience based on many thousands of machines.

In practically all cases the machine should be put into service in the condition it is received from the manufacturer. It has just been thoroughly tested, the brushes well bedded-in to fit the commutator contour, and the commutator itself finished to as high a degree of perfection as is possible without actual long-time running. It should, however, be very carefully watched during the first six months' service, because it is during this time that it is being finally polished by the action of the brushes, and is—or ought to be—assuming the glossy and generally chocolate-brown appearance which promotes long-wearing characteristics both for the commutator and for the brushes.

Unless burning or roughness appears, therefore, the commutator should not be touched with any grinder or sandpaper.

Roughness, Burning Remedies

Should any roughness or burning appear, however, the trouble should be immediately investigated and eliminated. Insufficient or excessive brush pressure, high mica insulation projecting above the commutator bars, overloading, whipping of belt, uneven gears, vibration caused by machine on which motor is mounted, or unequally-bedding brush surface, should be looked for and corrected.

If roughness appears, as it may do even on the best manufactured commutator—because of the "seasoning" of the mica while running, or from flashing caused by excessive starting load, by high "dynamic braking," or by heavy overload current—it should be removed by fine sandpaper—never by emery cloth, because emery dust will become imbedded in the bars and cause them to become abrasive like a lapping block. If sandpaper will not remove the roughness, a commutator stone may be used. If this also fails, the only remedy is to re-turn the commutator in a lathe. Care should always be taken that no oil gets on the commutator surface. Such oil will be absorbed by the insulation and cannot be removed except by rebuilding the commutator and replacing the oil-soaked mica.

If, owing to brush-chattering or other cause, commutator-lubrication appears necessary, a small amount of *paraffine wax* may be used during the time the commutator is seasoning. When a commutator is first manufactured, the surface is covered with innumerable microscopic ridges. These ridges cannot be removed except by the wear resulting from actual running over a long period. While it has not been definitely proved what is the action of the paraffine on a commutator of this sort, it would seem that the material fills in the minute valleys between the ridges and thus tends to prevent excessive wear of the brush during the seasoning-in time.

Apply Paraffine Sparingly

If paraffine is used, it should be applied *very sparingly*, by putting it on a piece of canvas in so small a quantity that it barely causes stiffening of the fabric. After applying this canvas to the commutator surface, the latter should be immediately wiped off thoroughly with a clean piece of canvas. Most modern commutators are of course "undercut"—that is, the mica insulation between the copper bars is cut down slightly below their level in order to avoid the risk of the mica extruding high enough during seasoning to prevent the brushes from maintaining continuous good contact with the bars themselves and so causing sparking and wear. "Experimenting" by novices in this highly specialized work invariably induces disastrous results.

With regard to the undercutting, I myself lean toward the V-type slot. The cutter producing this slot is so built that it not only removes the upper side of the mica itself but also a sufficient amount of the adjacent copper edges to form a small bevel at either slot-edge. To give the best results, a slot of this type may be cut much shallower than the usual U-type slot. I hold no brief against the U-type except where the motor is operating in dirty conditions, in which case it will often collect dirt and form a short-circuit between bars. On the other hand, the V-slot being wider and shallower at the opening, it is more likely to throw out the dirt than the U-type.

Type of Slot Important

On some motors, however, it is not desirable to use a V-slot. This applies particularly to very small motors. In these cases the commutator is small in diameter, so that the wider slotting necessary for the V-type produces what is practically a number of rather flat places on the commutator. These are naturally likely to cause jumping and sparking of the brushes. A U-slot is therefore preferable.

Despite the fact that many motors have been operated with insulation which is not slotted, and which is therefore flush with the commutator-surface, it would appear inadvisable on general purpose motors. After a motor has been manufactured, the seasoning and extrusion of the mica continues for quite a time. If, therefore, flush micas are used, it is necessary to use abrasive brushes from the start of operation.

Mechanical Defects Ruin $10 Picture Premiere

People don't know the difference between good, mediocre or just plain bad visual and sound reproduction—so runs the argument of the penny-pinching manager whose economy program centers about the projection room. Backers of the "Robber Symphony," adjudged by the International Cinema Exposition at Venice last summer as "one of the ten best pictures made throughout the world," arranged a swanky New York premiere, with the alleged elite present, at prices ranging from $2 to $10—for sweet charity, of course.

Leading Critic Raps Equipment

Very uncharitable, and extremely discerning, was critic Frank Nugent of the *N. Y. Times*, excerpts from whose review of the proceedings are very enlightening as to the reaction of so-called "non-technical" audiences. Witness:

"All the artistry in the world cannot take the place of sound mechanics in film manufacture, which is primarily a mechanical art. Nor can we shut our ears, although we wished we could, to the deafening metallic clamor of the sound track when the score overtaxed the microphones.

Machine Exacted 'Dreadful Penalty'

"The machine, which was unfortunately ignored in producing the picture struck back savagely on opening night. The projector rebelled several times, and the audience, which had been kept in the dark long enough, indulged in hoots, whistles and cat-calls. The sound boxes behind the screen creaked, buzzed and whined. Once, to the delight of some and the consternation of the rest, the film parted and the screen flashed a black-and-white invitation to 'visit your nearest Goodrich dealer.' By that time the rout was complete; art had a battered look about it. Possibly the machine has been placated by now, but it did exact a dreadful penalty."

CONSTRUCTIONAL CHANGES IN SOME SOUND SYSTEM COMPONENTS

By *LEROY CHADBOURNE*

STANDARD sound parts, presumably well-known to all projectionists, may be unrecognizable when seen for the first time in a modern design. Outward appearances have changed so greatly even in a few years that the projectionist who is perfectly familiar with his 1930 sound system may find it difficult to identify more than a few parts in a new installation.

A tube, of course, is a tube; but it may be a very different tube both in looks and in action. Many present-day condensers look more like early-type resistors than anything else. In some cases, as with condensers, the part functions on an entirely different principle. With transformers and chokes, on the other hand, both principle and construction remain unchanged, but appearances vary.

Many new types of tubes have been described, and their characteristics listed, in these pages. The present discussion is concerned not with tubes themselves, but with their accessories—resistors, condensers, and especially sockets. How does one tell the plate prong from the cathode prong in the newer sockets? Once that was easy.

Refer to sockets 4E and 4D of Fig. 1. There still are in use some thousands of theatre systems that have sockets of no other design. 4D was the RCA type; 4E the Erpi. There was only one chance to guess wrong; the second guess was bound to be right. The same sockets served rectifier tubes, as in 4C and 4B of Fig. 1. In many Erpi systems 4B was favored, with a jumper connecting Terminals 2 and 3. In the case of modern sockets it is possible, of course, to trace down wiring in detail until the socket connections become intelligible. But the audience may not be willing to wait that long. Schematic diagrams will not show socket connections. Wiring diagrams will, but are not often made available today. Tube data sheets are necessary. The data sheet or booklet issued by the tube's manufacturer will indicate a socket-type number, as well as the electrical characteristics of the tube itself. In the absence of a socket type-number, the tube data will include a socket drawing similar to Fig. 1. The really modern projection room must have on file socket drawings of every tube used. There is no other way to correctly and quickly identify socket connections.

[Ed.'s Note: I.P. has published such data for all RCA sound-picture tubes (Dec., 1936) and all W. E. sound-picture tubes (elsewhere in this issue).]

Thousands of earlier systems still in use have bayonet-type sockets, that is, sockets built with a shell into which the tube fits. The tube is inserted with a twist which locks a pin into a bayonet slot on the shell. The modern trend is almost entirely toward the straight plug-in type of socket. The tube is pushed straight down, and the contact prongs are gripped by spring contacts which provide physical support as well as electrical connection. A practical consequence of this type of construction is greater compactness, two tubes now occupying the space formerly needed by one, with a corresponding crowding of wiring.

Resistor Characteristics

In addition, modern sockets often have more than four terminals. Twelve socket terminals today may occupy less space than was taken by four in older equipment, and tracing down wiring becomes correspondingly more complex. Rule-of-thumb servicing, never entirely easy, is almost impossible with the new type of construction. Exact circuit data in the form of schematic diagrams as well as socket drawings is a prerequisite to any intelligent servicing policy.

Resistors used in theatre sound equipment have been considerably changed in appearance by the increasing preference for resistance compounds as against resistance wire. The wire-wound resistors were almost universally used in the earlier equipments. They consisted of a porcelain base, around which was wound iron or nichrome wire, the whole usually covered with a baked enamel that helped to dissipate heat. Terminals for connection protruded through the enamel covering. This is the type of resistor familiar to most projectionists. It still is found in more modern equipment, but the compound type is much more common.

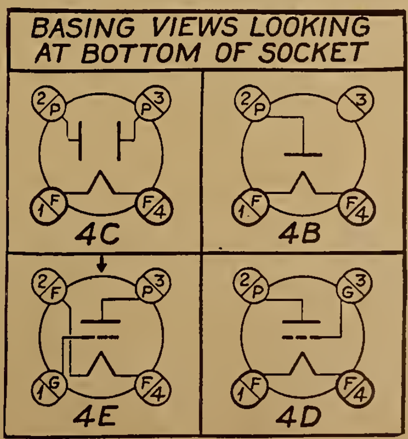


FIGURE 1

The compound pressed resistance has no wire at all, except for external connections. In a small way, it is comparable to an arc carbon that has been equipped with a connecting wire at either end. It is composed of special substances pressed or baked into a small cylinder. There is no way to guess the resistance value of the gadget by its physical size: one ohm and one megohm look exactly alike. The difference lies in the composition of the material used. The resistors are sometimes stamped or printed with their value in ohms. Because of their small size, the value may be abbreviated by leaving off zeros. Thus a resistor marked IM is 1,000 ohms; a resistor marked IMM is a million ohms, or a megohm.

The more common practice is to express resistor values by means of a color code. The code, which is simple and easily learned, consists of a combination of ten colors and three positions, on the resistor, where the colors may be placed. Knowledge of the code is a great aid to modern servicing, because by means of it the value of any resistor, its probable position in the circuit with reference to any given socket, and its probable function, are made known at a glance. The ten colors have the following values:

Brown	1	Blue	6
Red	2	Violet	7
Orange	3	Gray	8
Yellow	4	White	9
Green	5	Black	0

The three positions are, in the order given: body, end and band (or dot). The body color is read first, the end color next, and the band, or dot, last.

The first two, body and end, represent *figures*, according to the code. The last,

(*Continued on page* 20)

WESTERN ELECTRIC (ERPI) AM

Socket Connections Shown at Foot of Chart, wherein are key numbers, are bot

Code No.	Type	Base	Socket Connections	Max. Dimensions Length	Max. Dimensions Diameter	Type of Cathode	Cathode Rating Volts	Cathode Rating Amperes	Pl Vo
102G	Voltage Ampl. Triode	Medium 4-Pin Bayonet Type	Fig. 2	4-1/2"	2-3/8"	Filament	2.1	1	1
205D	Power Ampl. Triode	Medium 4-Pin Bayonet Type	Fig. 3	4-1/2"	2-3/8"	Filament	4.5	1.6	4
205E	Power Ampl. Triode	Medium 4-Pin Bayonet Type	Fig. 3	4-1/2"	2-3/8"	Filament	4.5	1.6	4
242C	Power Ampl. Triode	Large 4-Pin Bayonet Type	Fig. 1	7-15/16"	2-5/16"	Filament	10	3.25	12
252A	Power Ampl. Triode	Medium 4-Pin Thrust Type	Fig. 5	6-3/4"	2-11/16"	Filament	5	2	5
262A	Voltage Ampl. Triode	Medium 4-Pin Thrust Type	Fig. 7	5-1/4"	1-13/16"	Heater	10	0.32	1
264C	Voltage Ampl. Triode	Small 4-Pin Thrust Type	Fig. 5	4"	1-3/16"	Filament	1.5	0.30	1
271A	Power Ampl. Triode	Medium 5-Pin Thrust Type	Fig. 10	6-3/4"	2-7/16"	Heater	5	2	4
275A	Power Ampl. Triode	Medium 4-Pin Thrust Type	Fig. 5	5-5/8"	2-3/16"	Filament	5	1.2	3
281A	Coplanar Grid Tetrode	Medium 5-Pin Thrust Type	Fig. 9	6-3/4"	2-11/16"	Filament	5	1.6	2
284D	Power Ampl. Triode	Large 4-Pin Bayonet Type	Fig. 1	7-15/16"	2-5/16"	Filament	10	3.25	12
294A	Power Ampl. Pentode	Medium 5-Pin Thrust Type	Fig. 11	5-1/4"	1-13/16"	Heater	10	0.32	2
300A	Power Ampl. Triode	Medium 4-Pin Thrust Type	Fig. 5	6-1/2"	2-7/16"	Filament	5	1.2	4
309A	Voltage Ampl. Variable-Mu Pentode	Small 5-Pin Thrust Type	Fig. 12	4-29/32"	1-9/16"	Heater	10	0.32	2
310A	Voltage Ampl. Pentode	Small 6-Pin Thrust Type	Fig. 13	4-29/32"	1-9/16"	Heater	10	0.32	2

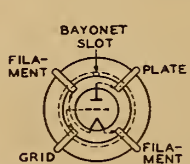


FIG. 1

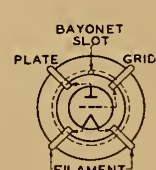


FIG. 2

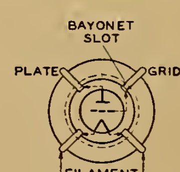


FIG. 3

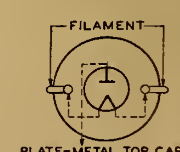


FIG. 4

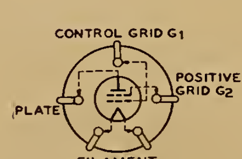


FIG. 9

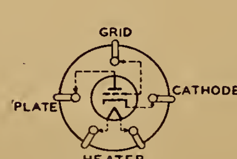


FIG. 10

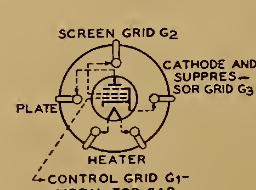


FIG. 11

Presentation of these data in this particular form, which includes certain identifying marks, is copyright

IFIER TUBES FOR THEATRE USE

iews of sockets. Use this Chart in Conjunction with Rectifier Tube Chart on page 21.

creen Grid Volts	Use	Plate Volts	Screen Grid Volts	Grid Bias Volts	Plate Current Ma.	Load Resistance Ohms	Power Output Watts	Amplification Factor	Plate Resistance Ohms	Transconductance Micromhos	Code No.
-	Amplifier	130 190	- -	-1.5 -2	0.58 1.46	- -	- -	29.8 30.2	63,000 43,000	470 700	102G
-	Class A Amplifier	350	-	-22.5	29	7600	.80	7.3	3,800	1940	205D
-	Class A Amplifier	350	-	-22.5	29	7600	.80	7.3	3,800	1940	205E
-	Class A Amplifier	1000 1250	- -	-42 -68	85 68	7000 8000	12 22	12.5	3,500	3600	242C
-	Amplifier	400 450 500	- - -	-50 -60 -70	60 60 58	3000 3000 4000	5 6.9 8.3	5.2 5.1 5.1	1,500 1,500 1,500	3500 3450 3450	252A
-	Voltage Amplifier	135	-	-7.5	0.7	145,000	-	13.7	29,000	470	262A
-	Voltage Amplifier	60 100	- -	-2 -8	2.4 2.1	58,500 62,000	- -	7.3 7.2	11,700 12,400	620 580	264C
-	Power Amplifier	350 450	- -	-25 -30	34.5 57.5	5700 4900	1.7 3.1	8.4 8.5	2,850 2,450	2930 3480	271A
-	Power Amplifier	200 300	- -	-45 -80	47 51	2060 4400	1.7 3.5	2.8 2.7	1,030 1,100	2770 2450	275A
-	Power Amplifier	130 250	72 65	-60 -70	35 45	2000 5000	2.2 4.2	5 5.2	3,400 3,600	- -	281A
-	Class A Amplifier	1000 1250	- -	-161 -220	80 64	8500 10,000	22.5 40	4.8	1,900	2500	284D
200	Power Amplifier	180 250	180 200	-18 -18	14.5 19.5	11,500 12,000	1.2 1.6	105 122	100,000 100,000	1050 1220	294A
-	Power Amplifier	350 450	- -	-74 -100	60 60	3000 4000	8.3 12.5	3.8 3.8	720 780	5300 4800	300A
-	Voltage Amplifier	180 250	75 75	-1.5 -1.5	4.8 4.85	- -	- -	1100 1450	1,000,000 1,300,000	1100 1110	309A
180	Voltage Amplifier	135 250	135 135	-3 -3	5.4 5.5	60,000 100,000	— —	- -	750,000 600,000	1750 2400	310A

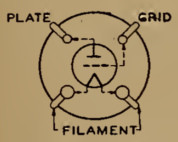


FIG. 5

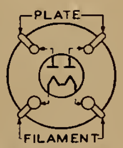


FIG. 6

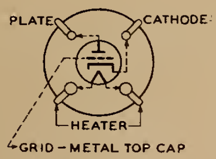


FIG. 7

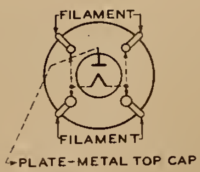
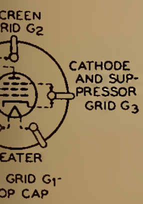


FIG. 8



G. 12

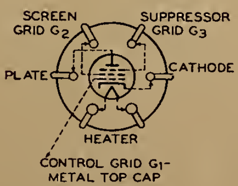


FIG. 13

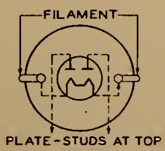


FIG. 14

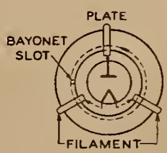


FIG. 15

WESTERN ELECTRIC (ERPI) AMPLIFIER TUBES FOR THEATRE USE

Socket Connections Shown at Foot of Chart, wherein are key numbers, are bottom views of sockets. Use this Chart in Conjunction with Rectifier Tube Chart on page 21.

Code No.	Type	Base	Socket Connections	Max. Dimensions Length	Max. Dimensions Diameter	Type of Cathode	Cathode Rating Volts	Cathode Rating Amperes	Plate Volts	Screen Grid Volts	Use	Plate Volts	Screen Grid Volts	Grid Bias Volts	Plate Current Ma.	Load Resistance Ohms	Power Output Watts	Amplification Factor	Plate Resistance Ohms	Trans-conductance Micromhos	Code No.
102G	Voltage Ampl. Triode	Medium 4-Pin Bayonet Type	Fig. 2	4-1/2"	2-3/8"	Filament	2.1	1	190	-	Amplifier	130 190	- -	-1.5 -2	0.58 1.46	- -	- -	29.8 30.2	63,000 43,000	470 700	102G
205D	Power Ampl. Triode	Medium 4-Pin Bayonet Type	Fig. 3	4-1/2"	2-3/8"	Filament	4.5	1.6	400	-	Class A Amplifier	350	-	-22.5	29	7600	.80	7.3	3,800	1940	205D
205E	Power Ampl. Triode	Medium 4-Pin Bayonet Type	Fig. 3	4-1/2"	2-3/8"	Filament	4.5	1.6	400	-	Class A Amplifier	350	-	-22.5	29	7600	.80	7.3	3,800	1940	205E
242C	Power Ampl. Triode	Large 4-Pin Bayonet Type	Fig. 1	7-15/16"	2-5/16"	Filament	10	3.25	1250	-	Class A Amplifier	1000 1250	- -	-42 -68	85 68	7000 8000	12 22	12.5	3,500	3600	242C
252A	Power Ampl. Triode	Medium 4-Pin Thrust Type	Fig. 5	6-3/4"	2-11/16"	Filament	5	2	500	-	Amplifier	400 450 500	- - -	-50 -60 -70	60 60 58	3000 3000 4000	5 6.9 8.3	5.2 5.1 5.1	1,500 1,500 1,500	3500 3450 3450	252A
262A	Voltage Ampl. Triode	Medium 4-Pin Thrust Type	Fig. 7	5-1/4"	1-13/16"	Heater	10	0.32	180	-	Voltage Amplifier	135	-	-7.5	0.7	145000	-	13.7	29,000	470	262A
264C	Voltage Ampl. Triode	Small 4-Pin Thrust Type	Fig. 5	4"	1-3/16"	Filament	1.5	0.30	100	-	Voltage Amplifier	60 100	- -	-2 -8	2.4 2.1	58500 62000	- -	7.3 7.2	11,700 12,400	620 580	264C
271A	Power Ampl. Triode	Medium 5-Pin Thrust Type	Fig. 10	6-3/4"	2-7/16"	Heater	5	2	450	-	Power Amplifier	350 450	- -	-25 -30	34.5 57.5	5700 4900	1.7 3.1	8.4 8.5	2,850 2,450	2930 3480	271A
275A	Power Ampl. Triode	Medium 4-Pin Thrust Type	Fig. 5	5-5/8"	2-3/16"	Filament	5	1.2	300	-	Power Amplifier	200 300	- -	-45 -80	47 51	2060 4400	1.7 3.5	2.8 2.7	1,030 1,100	2770 2450	275A
281A	Coplanar Grid Tetrode	Medium 5-Pin Thrust Type	Fig. 9	6-3/4"	2-11/16"	Filament	5	1.6	250	-	Power Amplifier	130 250	72 65	-60 -70	35 45	2000 5000	2.2 4.2	5 5.2	3,400 3,600	- -	281A
284D	Power Ampl. Triode	Large 4-Pin Bayonet Type	Fig. 1	7-15/16"	2-5/16"	Filament	10	3.25	1250	-	Class A Amplifier	1000 1250	- -	-161 -220	80 64	8500 10000	22.5 40	4.8	1,900	2500	284D
294A	Power Ampl. Pentode	Medium 5-Pin Thrust Type	Fig. 11	5-1/4"	1-13/16"	Heater	10	0.32	250	200	Power Amplifier	180 250	180 200	-18 -18	14.5 19.5	11500 12000	1.2 1.6	105 122	100,000 100,000	1050 1220	294A
300A	Power Ampl. Triode	Medium 4-Pin Thrust Type	Fig. 5	6-1/2"	2-7/16"	Filament	5	1.2	450	-	Power Amplifier	350 450	- -	-74 -100	60 60	3000 4000	8.3 12.5	3.8 3.8	720 780	5300 4800	300A
309A	Voltage Ampl. Variable-Mu Pentode	Small 5-Pin Thrust Type	Fig. 12	4-29/32"	1-9/16"	Heater	10	0.32	250	-	Voltage Amplifier	180 250	75 75	-1.5 -1.5	4.8 4.85	- -	- -	1100 1450	1,000,000 1,300,000	1100 1110	309A
310A	Voltage Ampl. Pentode	Small 6-Pin Thrust Type	Fig. 13	4-29/32"	1-9/16"	Heater	10	0.32	250	180	Voltage Amplifier	135 250	135 135	-3 -3	5.4 5.5	60000 100000	— —	- -	750,000 600,000	1750 2400	310A

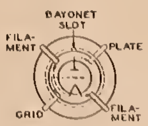


FIG. 1

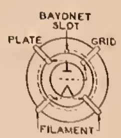


FIG. 2

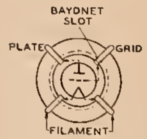


FIG. 3

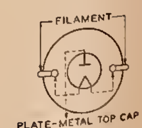


FIG. 4

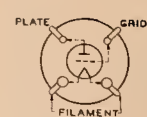


FIG. 5

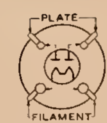


FIG. 6

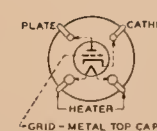


FIG. 7

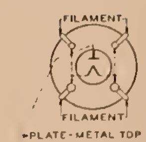


FIG. 8

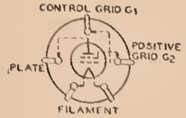


FIG. 9

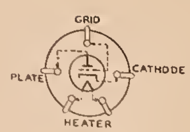


FIG. 10

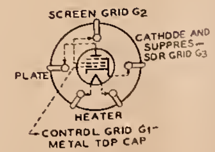


FIG. 11

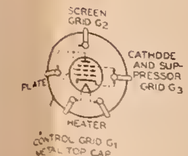


FIG. 12

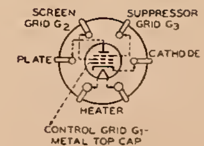


FIG. 13

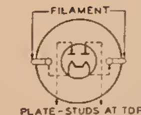


FIG. 14

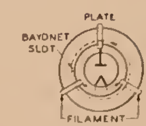


FIG. 15

CHANGES IN SOUND SYSTEM COMPONENTS

(*Continued from page* 17)

the band or dot, does not represent a figure, but a *number of ciphers*. Thus, if the dot is blue, six ciphers follow after the numbers given by the body and the end. Suppose the body to be brown and the end black, with a blue band or dot. Then for the body write 1, for

FIGURE 2

the end write 0, and for the dot 000,000—total value, 10 million ohms, 10 megohms. Suppose the body to be red, the end black, and the dot black. Write for the body 2, for the end 0, and for the dot add no zeros—20 ohms.

All values of resistance are taken to the nearest code number. The code cannot indicate a value of, say, 1,234 ohms. Such a value must be coded as brown body, red end and red dot—1200 ohms. Or if the value were 1274, it would be coded as 1300 ohms. Resistors of this type are not made in odd values, such as 1234 or 1274. If such values be required, a 1200-ohm resistor is wired in series with one of 30 and one of 4 ohms, or one of 70 and 4 ohms.

The wattage ratings of the newer resistors, as of earlier types, can be gauged roughly by physical size. The half-watt size are about the thickness of a match, and something like ¾ inch long. One-, two- and five-watt sizes are substantially identical in appearance—roughly ¼ inch in diameter and 1¾ inches long. This size is by far the most common. Resistors of this appearance, capable of carrying more than 5 watts, range up to the physical dimensions of a fountain pen, but are not very common; the familiar wire-wound enamel type is still preferred for power work.

Transformers and Chokes

Size as well as the color code are helpful in handling these resistors. The half-watt size is almost certainly a grid resistor carrying no current. The functions of many of the others can often be deduced by their resistance values as given by the color code. If the characteristics of the tube with which they are associated are known, the color code will help distinguish resistors according to the work they perform. Detailed knowledge of the code and of tube characteristics will sometimes prove helpful when tube socket data is not available.

Transformers and choke coils have changed least of any component parts used in sound work, and are most easily recognized even in the newest equipment. Some confusion may arise out of the fact that sound transformers are now likely to be much smaller, for the same sound power, than in earlier systems. More important, they are now often made with a large number of connection terminals, of which only a few may actually be used. The reason for this lies partly in the multiplicity of tubes now available. On a purely commercial basis, the manufacturer finds it advantageous to build one instrument, with numerous taps, that will match a great many tubes, rather than maintain separate transformer models for each new type of tube introduced.

The existence of unused taps on transformers should not confuse the projectionist. However, it is vitally necessary, before removing a wire from any such transformer, to make certain that it will go back to the same prong. If failure to restore the wire to its proper place only stopped sound, the trouble would be less serious. Sound likely will not

FIGURE 3

stop, but become distorted. The distortion may be noted later, and the cause very difficult to find. The best bet is always to tag the wire and, if the prong is not numbered the prong, too. A modern sound transformer is shown in Fig. 2.

Power transformers also have undergone some change, not in design but in the way they are used. Most older amplifiers used separate plate and filament transformers, which is seldom done today. Almost invariably a single unit carries both plate and filament secondaries; and if a separate grid bias rectifier is used, the same transformer provides plate and filament power for that tube also.

Next to tube sockets, condensers show the greatest change of any sound equipment component. A projectionist familiar only with the older, more bulky kind can easily fail to recognize many of the current models. Condensers today may look like fuses, like resistors, like cardboard boxes; or they may have aluminum shells.

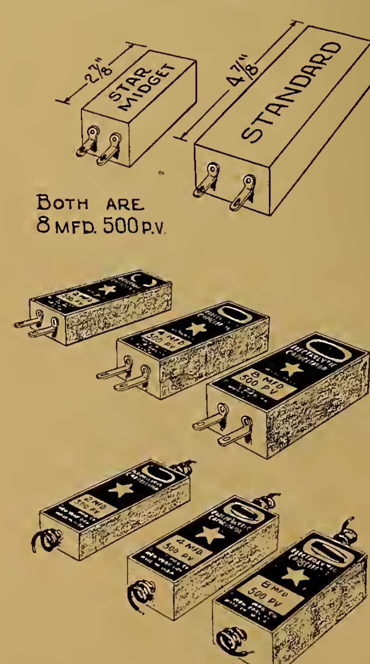
Radical Condenser Changes

Early sound condensers were always of the paper or mica type—that is, they consisted internally of alternate sheets of metal foil and resistance material such as paper, an assemblage of which was mounted in a metal can, and often sealed in place with an insulating compound.

Condensers of the same construction still are used, but are built more compactly. A long strip of paper is placed over a long strip of metal foil; then another strip of foil goes on top of the paper, and the whole is rolled into a tight spiral. The spiral is then subjected to high pressure, which reduces it to the smallest possible physical dimensions. The result is both a cheaper and a better product. The compressed spiral may be mounted, according to the earlier practice, in a metal can and sealed in place. Frequently, however, it is pressed into a wax-impregnated cardboard box.

Such condensers do not differ greatly from the earlier type. Electrolytic condensers, however, differ enormously not only from other kinds but among themselves.

An electrolytic condenser is used in a d.c. line only. It has an anode, a



cathode, an electrolyte (liquid or liquid paste), and an insulating layer or film formed on the anode by the chemical action of the electrolyte. This film is microscopically thin but capable of with-

WESTERN ELECTRIC (ERPI) RECTIFIER TUBES FOR THEATRE USE

These data in this particular form copyrighted 1937 by "International Projectionist". Reproduction in whole or in part prohibited.

Code No.	Type	Base	Socket Connections	Cathode Rating		Max. Inverse Potential- V.	Max.Peak Plate Current Amperes	Load Potential (V.) Unfiltered Circuit	Load Current in Milliamps. For Unfiltered Circuit	Max. Ambient Temp. Range
				Volts	Amperes					
219D	Half-Wave High Vacuum	Large 3-Pin Bayonet Type	Fig. 15	14	6	3500	0.5	1000 Volts	250 (DC from two tubes - full wave)	-
249B	Half-Wave Mercury Vapor	Medium 4-Pin Thrust Type	Fig. 8	2.5	7.5	7500	1.5	2300 "	1000 (DC from two tubes - full wave)	0-50° C.
253A	Half-Wave Mercury Vapor	Medium 2-Pin Thrust Type	Fig. 4	2.5	3	3500	0.5	1000 "	300 (DC from two tubes - full wave)	10-50° C.
258B	Half-Wave Mercury Vapor	Medium 2-Pin Thrust Type	Fig. 4	2.5	7.5	7500	1.5	2300 "	1000 (DC from two tubes - full wave)	0-50° C.
263A	Full-Wave Argon Filled	Medium 2-Pin Thrust Type	Fig. 14	2.5	15	100	6	25 "	4000 (DC from one tube)	-
274A	Full-Wave High Vacuum	Medium 4-Pin Thrust Type	Fig. 6	5	2	660 (AC voltage per plate R. M. S.	-	550 " 450 "	160 (Choke - Input Filter) 140 (Condenser " ")	-
314A	Full-Wave Mercury Vapor	Medium 4-Pin Thrust Type	Fig. 6	5	5	300	2.5	80 "	1600 (DC from one tube)	0-50° C.
288A	Half-Wave Argon Filled	Mogul	-	2.2	19	300	18	60 "	12000(DC from two tubes - full wave)	-

NOTES: This chart refers to Rectifier Tubes only, and may be used with chart of Amplifier tubes shown on the second preceding page. All tubes listed above utilize a filament-type cathode. Warning: other manufacturers' tubes with similar code numbers have unlike characteristics.

standing hundreds of volts. Since the capacitance of any condenser increases with the nearness of its plates, the extreme thinness of the insulating film makes possible great capacitance in extremely small space. Whereas earlier sound amplifiers often used bulky and heavy banks of condensers, the same work is now done by a bit of cardboard or aluminum not much larger or heavier than a package of cigarettes.

Electrolytic condensers are of two general kinds—"dry" and "wet". The dry type is not actually dry—that is, without moisture—any more than a "dry battery" is without moisture. In both, the electrolyte is present in the form of a paste or jelly in which the moisture content has been reduced to the absolute minimum required by the chemical action. The anode of the electrolytic condenser is usually aluminum; the cathode aluminum or copper. Solutions of sulphuric acid, or of boric acid and ammonium or sodium borate, are used as electrolytes.

The finished condenser, especially the dry type, may be built into a cardboard container, with a wire protruding at each end that resembles one of the resistors mentioned previously, although slightly larger and thicker. It may be built into a cardboard box, or an aluminum can, as shown in Fig. 3. The aluminum can of Fig. 3 contains two

FIGURE 4

condensers, each of 8 microfarads, 500 volts rating, connected in parallel. The parallel connection is the reason why there are only three terminals: the negative is common. Condensers of this type are often used as rectifier filters.

Electrolytic condensers cannot be used in a.c. lines, because their insulating film will break down. The insulating film will also be destroyed if these condensers are connected in reverse polarity. Here is another departure from the older order of things: polarity was unheard of in connection with the earlier-type paper

or mica condensers. It must be watched carefully, however, in the case of electrolytics.

Electrolytic condensers will often heal themselves after puncture—still another change. The insulating film is restored by chemical action when the unit is connected in proper polarity, provided the flash-over has not been very great. This is another point to keep in mind in servicing equipment that uses condensers of this nature.

Since electrolytic condensers are not useful in a.c. lines, the earlier paper or mica type still holds a place in sound equipment, although somewhat modified in construction. Fig. 4 shows a 2-microfarad paper condenser built for two thousand volts.

There is no more striking and conspicuous change in sound equipment than the progress from the earlier type "fader" or volume control to the inconspicuous potentiometer now often built into the amplifier as merely a minor part of that circuit. The older fader, wired in a transmission line, had to maintain impedance match regardless of changes in setting, and was of the "pad" type construction, with terminal studs through which the sliding contact made connection to the different coils.

The newer volume control is connected in the grid circuit of an amplifier, and impedance match is unimportant. It is a simple wire-wound or carbon potentiometer. The carbon type consists of a semi-circle of smooth carbon compound, having the desired resistance value, over which a contact slides. The wire-wound type is identical in construction with the familiar filament rheostat of earlier days, except that wire of very high resistance is used. Both types are often tapered—that is, as the contact is moved the resistance does not change in direct proportion, but in a logarithmic ratio, conforming to the response of the human ear.

Potentiometers of this type of construction are made with several different tapers, depending on their application. In ordering replacements always specify that the unit will be used as an audio volume control, insuring that the replacement will have the correct taper. The wrong taper will make proper volume control difficult; depending on the position of the slider, sound will either change drastically in volume at the slightest touch or hardly change at all when the control is moved over a fair portion of the circle.

(NOTE: Questions suggested by the foregoing article are solicited and will be answered promptly.)

Nebraska Forces Room Ventilation Following Arc Exhaust Tests

THAT the carbon arc used in projecting motion pictures contributes to the definite occupational hazards attendant upon such work has long been known by well-informed observers. The stumbling block in the path of those who are constantly striving for improvement of projectionist working conditions is a hyra-headed group consisting of apathetic craft representatives, penny-pinching exhibitors, and either inefficient or corrupt inspectors who are charged with enforcement of such beneficial laws as exist.

The present enlightened policy of state industrial commissioners and labor departments is made apparent in the appended excerpt from the twenty-sixth biennial report of the Nebraska State Department of Labor for the period ending Dec. 31, 1936. Particularly interesting are the findings set forth in the appended excerpt therefrom, which should be added to the files of projectionist organizations everywhere. The prompt action taken by this Nebraska department is indicative of the gratifying results obtainable by an alert and sympathetic state agency.

I. P. is indebted to Carl White, manager of the Quality Theatre Supply Co., Omaha, Nebraska, for directing its attention to this report. The excerpt follows:

The Labor Department in 1935 was confronted by a serious problem, the existence of which everybody connected therewith seems to have been ignorant. About the first of September complaints were made to the Department regarding conditions in several theatre projection rooms. Investigation showed poor ventilation and unsanitary conditions in these booths. Inquiry of the operators working there indicated that some of them were suffering from some unexplained ailment.

Carbon-Monoxide Poisoning Diagnosis

About the same time a projectionist who had been in poor health for some time, changed physicians and consulted a physician familiar with the effects of toxic gases, who, upon investigation, was convinced that the cause of this man's ailment was from gases generated from the carbon arc light. This physician collaborated with the Labor Department in some blood tests and other investigations regarding this situation, which, together with reports from projectionists convinced us that a condition existed which must be remedied. Carbons used in these lights were secured by the Labor Department and at our request the State Health Laboratory ran some tests, the result of which is explained in the following report made to the Department:

"Following information from you of a number of cases of chronic illness occurring among motion picture projectionists employing the carbon arc light for illumination purposes, some of these cases having been tentatively diagnosed as carbon-monoxide poisoning, and at your suggestion that the Laboratory aid in attempting to determine the nature of poisonous fumes emanating from the carbon arc light, some experiments were undertaken which will be discussed in the paragraphs to follow.

"An apparatus was arranged to collect the fumes from above the carbon arc and cause them to pass through an enclosed glass chamber at a regular uniform rate. Guinea pigs exposed to such fumes in this chamber showed restlessness and irritation beginning a few minutes after exposure had started and progressing with increased intensity, the animals staggering around until at the end of *forty-five minutes to one hour* the animals so treated were unable to stand any longer. They were then removed from the chamber and a rapid recovery of the animals to apparently normal state followed.

Gas Test Reaction of Animals

"An absorption train designed to absorb nitric oxide but to permit the passage of carbon monoxide was introduced between the carbon arc and the glass chamber. Tests for nitrites showed that this absorption train did not remove all of the nitric oxide gases, but indicated that the amount of such gases reaching the chamber were considerably reduced. Guinea pigs exposed to the fumes in this chamber following such absorption showed no signs of irritation or toxicity at the end of 1½ and 3 hours' exposure, respectively.

"Spectroscopic examination of the bloods taken from these two series of experiments were made immediately following the experiment. The spectroscopic appearance of the blood from the animal exposed to the unaltered fumes showed an abnormal spectrum identical with normal blood. No spectroscopic evidence of carbon monoxide poisoning could be found in the blood of the animal so exposed.

Prove Importance of Ventilation

"The fact that nitrogen oxides are produced by the arc and that these oxides are toxic is not new knowledge. However, these brief experiments illustrate the importance of adequate ventilation to prevent exposure of workers to the fumes from the arc. The experiments conducted showed definite evidence of considerable toxicity resulting from the nitric oxides, but showed no evidence of other poisonous substances in the fumes from the carbon arc light."

Between September and the end of the year 1935, practically every theatre projection room in the state was inspected, and wherever improper conditions prevailed recommendations were made to eliminate the trouble. A simple, cheap, home-made forced ventilating system was devised and drawings made. Blueprints were furnished to all theatres where there was improper ventilation.

PHASE INVERSION BOOKLET

The phase inversion technique as practiced in Europe and America alike, is dealt with in detail in the June, 1936, issue of the Aerovox Research Worker. Because of the widespread interest in phase inversion, additional copies have been run off and made available to anyone writing to Aerovox Corp., 70 Washington St., Brooklyn, N. Y., without charge or obligation.

The IP EDITORIAL PAGE

Vol. 12, No. 2 FEBRUARY 1937

Industry Rights in the Television Field

The industry trade press reports that in the proposed new recording agreements between the producers and Erpi the latter is demanding as a consideration for signing that all technical developments by producer employees relating to "electrical communication of intelligence" (a nice phrase covering the entire field of communications, including television) be made available to Erpi, meaning A. T. & T. This demand opens up an interesting field of speculation.

The first contracts between Erpi and the producers provided that the latter make available to Erpi the rights to any development relating to the *sound picture field*, including disc and film recording and reproduction. Anybody knowing their Hollywood would certainly not complain about such a clause, because the telephone company, after expending huge sums to develop *sound-picture* equipment, was entitled to some measure of protection from the Hollywood pseudo-scientist vultures. So far, so good.

The current Erpi-contract demand is a different proposition altogether. Why? First, because until 1952 at least neither A. T. & T. nor any of its subsidiaries *have any rights* to etherized (that is, without wires) television, as a result of the agreements stemming out of the consent decree accepted by the government in the now-famous Wilmington, Del., anti-trust suit. All such rights rest with RCA. Is A. T. & T., then, figuring on engaging in wired television, say in populous dollar-density centers such as New York, Chicago, Boston, Philadelphia, San Francisco, and like centers? Maybe. It would be comparatively easy, for example, to encircle New York with offshoots of a coaxial cable, the cost of which would be as nothing compared with potential income.

The experiences of A. T. & T. during the recent investigation by the Federal Communications Commission into the former's activities occasioned no little concern by A. T. & T. for the safety of its fundamental nickel-in-the-slot business, apart from sound pictures or any other subsidiary activity. Was the scare sufficient to deter A. T. & T. from future excursions into non-telephone fields? Probably not, in view of this latest Erpi demand relative to film-company developmental rights. Now, nobody could or would object to A. T. & T. participation in the television field. While their agreement with RCA on etherized rights runs until 1952 (which might as well be forever), they are perfectly free to dabble in *wired* television. But why should the motion picture business be called upon to put the telephone company into the wired television business? Because of huge A. T. & T. expenditures for television development? Nonsense. Here we have an altogether different pattern from that relating to sound pictures.

Erpi rights to sound-picture developments are more or less clearly defined. Priority in sound pictures through their own development work, or through acquired rights, is no longer a burning issue. But by this time it is clearly evident that motion picture film will play quite an important part in the development of television. What specific rights does A. T. & T. (through Erpi) have in the film business *per se?* Long before Erpi was in existence the film industry had at work technicians who contributed mightily to the development of the motion picture film art; and they continued to do so even after sound pictures came in. Priority in film developments for the motion picture industry *per se* is no less well-defined than priority for Erpi in the sound picture field.

Why should the motion picture industry assent to an inclusive agreement which would automatically and without charge transfer to Erpi rights which were conceived and worked out before Erpi ever existed, before the telephone company ever entered the theatrical field? Before sound pictures, motion pictures constituted an industrial entity!

What would happen if the industry refused to sign the Erpi agreements now pending? Answer: nothing. Fortunately, such is the situation today that Erpi could do nothing about such a refusal. After all, the motion picture industry will have a vitally important stake in television, the accuracy of which statement is self-evident. Why, then, should the industry now sign away its stake as part of an agreement for the recording of *sound pictures*, far in advance of the introduction of television? The answer is that it shouldn't.

The motion picture and the television industries are destined to have much in common: for the former as a means of survival and for the latter as a tremendous lift in its early stages. Such advantages as the picture industry will enjoy as a result of this inevitable tie-in, whether relating to patent rights or otherwise, will accrue to it as *a matter of right*, as the fruits of thirty years of progress. The demand by any sound-picture company that the motion picture industry sign away these rights as a mere detail to an ordinary sound-picture recording agreement (such recording no longer being surrounded with an aura of mystery or obtainable from only one source) is presumptuous in the extreme and wholly unwarranted on any reasonable basis. This provision in the contracts should be red-inked. The industry needs no booking agent to peddle its hard-earned rights.

Security Equally Important As Efficiency

Disinterested persons, if acquainted with the efforts of the motion picture business to effect an agreement on reel length, would marvel at the ineptness of the fifth largest industry in the world. The organized craft based its opposition to this new standard on two points: safety considerations and the probability that the use of long reels will ultimately result in decreased manpower. The distributors scoffed at these objections, and particularly at the latter. However, even before the general introduction of the larger reel exhibitor leaders in Chicago and elsewhere cited double reels as a reason for decreased manpower. Granted that this process of thought is bereft of any reason, the fact remains that the double-reel standard is bound to engender such sentiments among exhibitors.

Numerous correspondents have inquired as to the stand of I. P. on this proposition. Certainly not a disinterested party, I. P. can only repeat its reminder of several months ago to the distinguished F. H. Richardson, who worked up a fine froth anent "organization opposition" to the long reel, *i. e.*, that there are some things vastly more imporant than efficiency, and of these security is one. Assuming that the double-reel standard is perfect technically and does not lessen the factor of safety, no person or organ claiming to have projectionist welfare at heart—and certainly not I. P.—can ignore the reasons underlying craft opposition thereto.

EYE-STRAIN: A DEFINITE OCCUPATIONAL HAZARD FOR PROJECTIONISTS

Notes on Some Causes of Projectionist Eye-Strain and how Best to Avoid it

By *CHARLES R. UNDERHILL, Jr.*

RCA FIELD SERVICE ENGINEER, PITTSBURGH, PENNA.

THE conditions which surround and affect the life and development of civilized man are extremely complex and varied, and represent the relative advancement of a primitive or ancient people. Progress in the arts and science requires man to depend upon the sense of sight more than upon any other. The evolution of the eye was complete eons before there were any schools or printing presses or electric lights. The eye acquired the ability to take care of itself under extreme conditions of illumination from mid-night to mid-day. In those days it served the needs of the human animal perfectly.

The tallow candle has been but lately displaced by the various forms of artificial lighting, which have caused most of us to prolong our vocations and avocations into hours when primitive man was forced to rest. Within the last couple of decades has come the moving picture.

The visual organ is imperfectly fitted for all those new developments. Is it reasonable to expect that Nature should have provided for all of them and produce an organ that could respond to these new demands?

Projectionists Severely Exposed

The environment of a motion picture projectionist causes strain on the eyes not experienced by the average person; still it is not as direct in destructive results as certain other unusual occupations. However, where the eye-strain is more pronounced, precautionary practices have become well established. Steps are being taken to check the ravages of civilization upon the human eye, and projectionists must know how to properly control the light in their projection rooms so that it is safe and practical and will cause no undue strain on their eyes.

Statistics indicate that nine out of every ten persons living under civilized conditions have imperfect sight, and as the age increases, the proportion increases, until at forty it is almost impossible to find a person free from visual defects. Disturbances of the circulation, the digestion and the kidneys are said to affect the eyes, so that abnormal use of the eyes during such times may cause severe strain and suffering.

Every projectionist knows that the direct rays of a carbon arc will hurt his eyes. He avoids looking into the direct arc for this reason. Not every projectionist knows that the danger lies not alone in the intense brilliance of the light but *in its nature;* also, that the reflected (indirect) light from the carbon arc has the same injurious properties as the direct light, though the reflected light is not as bright. Many projectionists have experienced "sunburn" from exposing the skin of their arms, neck or face to these rays. The reason for this is that the rays are rich in ultra-violet (invisible), light. It is these rays in both the sun and the carbon arc that cause sunburn.

These rays will not pass through ordinary glass, though they will pass through quartz. Thus, plain glass will protect one from these rays. Under regulated conditions, carbon arc rays have great therapeutic value, but uncontrolled they are very harmful. That reflected light is effective, let it be recalled that a bad case of sunburn can be more quickly attained at the seashore due to the reflected ultra-violet rays of the sun from the surface of the waves.

Seal hunters of Newfoundland and the scalers of the 14,000 ft. Materhorn in the Alps know that in very clear or rarified atmospheres snow and ice reflect the sun's rays in countless directions, though they strike the earth but from one direction. They wear goggles under such conditions, for they know the tortures of snow- and ice-blindness. This blindness, though temporary, is a serious thing and a terrible sensation. It is like having sand thrown into the eyeballs. Water runs out of the eye. With a good dose of it, men have become almost insane.

Most surfaces of the earth absorb enough of the sun's rays to make the reflected light comparatively feeble and entirely harmless. Also, in most heavily populated sections the atmosphere is sufficiently laden with dust or smoke particles to reduce the light intensity to a degree where the reflected light from snow or ice can cause no harm to normal eyes. Under such conditions one can look directly into the sun without harmful effects.

General Room Illumination

The most subtle but positive cause of eye trouble among projectionists is working in an improperly lighted room. Assuming that most projectionists use reasonable care about letting direct or reflected light from the carbon arc reach his eyes, there are many rooms in which light is not properly distributed over the major portion of the working area. The practice is often made of turning off all lights after threading-up, rewinding, checking carbon trim, *etc.*, so that no light is visible except that from reflected sources from the arc lamp and exciter lamp, and the glow of the amplifier tubes. Some projectionists use varied forms of subdued lighting, such as long tubular reflectors over ceiling lights allowing a small circle of light directly at the point of threading up or rewinding; or bulbs of very low candlepower are used in dull reflectors. In extreme cases, walls and ceilings have been painted dull black.

Various motives cause the projectionist to operate under such conditions. They claim they can see the picture on the screen better, being more certain of catching the change-over cues, particularly where there is glass in the ports.

The most mistaken idea about a dark projection room is that it is easier and more restful on the eyes. Under the conditions incident to projection work, nothing could be farther from the truth, and damage inevitably will result to the eyes. This will become manifest by headaches and pain in the eyes. The reason is that the contrasts of light within a darkened booth are tremendous.

The iris is a remarkable automatic device within the eye which regulates the amount of normal light reaching it. Though the muscles of the iris are automatic, they are rather slow. Sudden contrasts of strong light and weak illumination are painful and harmful to

(*Continued on page* 27)

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

ELIMINATION for the present of any possible threat to the I. A. through activities of the C. I. O., liberal labor group headed by John L. Lewis, was accomplished through receipt by Local 306, N. Y. City, of a letter from John Brophy, first assistant to Lewis, which emphatically denied any connection whatsoever between his group and the United Theatrical Workers, headed by B. Deckoff, whose activities in the theatre field have been used as a bogey man to frighten I. A. adherents. L. U. 306 gave no publicity to this letter because United activities stalled abruptly in N. Y.

Deckoff has been active in New England lately. He recently sought to organize the Boston exchange workers, but got nowhere. Providence L. U. 223 was annoyed by one unfair theatre the workers in which claimed affiliation through United with the C. I. O. In fact, L. U. 223 was stymied for a while, being unable to get a hearing in the press for their side, so effectively did United sell the idea of its C. I. O. affiliation. L. U. 306 is understood to have aided by providing certified copies of the Brophy disclaimer.

Deckoff's activities are difficult to understand, his background being obscure, his backing unknown, and his movements evidencing "inspiration" by remote control. However this may be, his utter lack of success to date, plus the C. I. O. disavowal to L. U. 306, effectively riddles the straw bogey man erected by fears of either Deckoff or the C. I. O.

Selznick Color Film Sked.

Selznick International's film lineup of from 10 to 12 A pictures will be about evenly divided between Technicolor and black-and-white, it is learned, making it the only studio with a definite color program for the coming year.

New German 'Depth' And Color Film Processes

At a recent film Congress in Hamburg, Germany, special interest was shown in a new process developed by T. P. Etbauer for showing films stereoscopically, reports the U. S. Trade Commissioner. Mr. Etbauer discards the double-picture principle used heretofore and endeavors to obtain depth by the use of a one-picture process. He uses what is called a "fan screen," that is, two mirrors inclined to each other at an angle of 15 degrees. By this process, any films can be made to appear stereoscopic.

There are no extra costs of any kind in making the film itself. At the moment, the process is still in the experimental stage, but will shortly be tried out in practice. Experts expressed high approval of the demonstration.

The same source reports that a new color film process, still largely in the experimental stage, has been developed by the I. G. Farben concern. The process, known as the AGFA-Color process, is based on a patent (the same on which the Kodachrom-3-color film is based) taken out by a Berlin physician, Dr. Ernst Fischer, 25 years ago. The AGFA process attempts to solve the color film problem chemically in contrast to the optical solution of the Opticolor method.

10% Mirrophonic Price Rise

A general price increase of 10% on all Mirrophonic sound equipment contracts became effective February 1, it was announced by Erpi, who ascribed the increase to a rise in manufacturing and operating costs.

Screen Illumination, Framing Excite Academy Interest

Recognizing an apparent confusion and lack of standard procedure in both studio and theatre projection rooms in the "framing" of pictures, the Academy of M. P. Arts & Sciences will investigate the possibilities for standardizing framing of the picture in the camera and projector apertures. Also, the Council approved a report containing a proposed Standard Electrical Characteristic for Theatres, to be released soon, designed to improve the quality of theatre sound projection by more closely coordinating studio sound recording and theatre reproducing system characteristics.

A report recommending that the Council inaugurate a nation-wide survey to measure screen illumination in all theatres in the U. S. was approved and plans are now being made to inaugurate this measurement survey.

2-Men Penna. Bill for Houses Over 300 Seats

An act introduced in the Pennsylvania legislature requires two licensed projectionists in all theatres with a seating capacity of 300 or more. The measure has been referred to the committee on labor. Another act introduced requires theatres of similar seating capacities, having a stage or space in back of the prescenium of 10 feet or more in depth, to install an asbestos or steel curtain, or both.

Theatres falling in this classification are also required under this act to have a main control switchboard which shall control all lights in the auditorium and every passage way leading from the auditorium to the streets. An attendant is required to be present to supervise the enforcement of this act.

A two-men bill has been introduced in the N. Y. State legislature and has been referred to the committee on cities. The measure provides for issuing of licenses for one year either by the mayor or a licensing body and a top fine of $100 or a maximum of three months' imprisonment for violations.

Theatres Use 16mm. Film

Theatres in at least four Colorado cities are using 16-mm film in showing local sports events, festivals, fairs, and other happenings which have only a vicinity appeal. J. H. Cooper Enterprises, Inc., theatres in Greeley, Colorado Springs, Pueblo and Grand Junction have installed the 16-mm projectors. If a photographer takes the shots he furnishes the film in return for screen credit, but the theatre pays the bill if someone outside the trade does the work.

Warner Bros. Fine Profit

Warner Bros. Pictures, Inc., and subsidiary companies report for the 13 weeks ending Nov. 28 last a net operating profit of $2,047,936.28, after deducting all charges including amortization and depreciation and normal Federal

---

What's Ailing The Movie Industry, No. 4671

Thanks are due and hereby extended to Leslie Linick of Chicago for mailing in the appended editorial from the *Chicago Tribune*, which modestly terms itself the world's greatest newspaper. Oh, well, we suppose it has to be right sometime:

A glance at the motion picture ads shows that four out of five neighborhood movie houses in Chicago have broken out in a rash of double features. This double-feature business may be a bargain in the eyes of the exhibitors. To many or most of us it's just a pain in the neck. By some fatal timing we always have to sit through three-quarters of the picture that bores us to see the one for which we paid our money. Furthermore, there's no Mickey Mouse.

Double features substituting quantity for quality seem in the present instance to be the exhibitors' answer to the ban on bank nights and similar prize drawings which forced the movie houses to get out of the lottery business and stick to the amusement field.

If so, the exhibitors are picking on the wrong people.

---

income taxes, but before providing for Federal surtaxes on undistributed earnings.

Develop, Fix in 1 Process

Hauff A.G., of Feuerbach, Wuerttemberg, according to the German press, has just brought out a solution under the trade name "Unigen" which is said to develop and fix photographic film in one process. This eliminates the necessity of developing in one bath, washing in another and fixing in a third. No information is available on the contents of the solution.

N. D. Passes Bill Forcing Producer-Theatre Divorce

The North Dakota legislature has passed by vote of 74 to 30 a bill compelling producers of motion pictures to divorce themselves from theatre holdings. Measure has been up in several states, but this is first time it passed a state legislature. Doubt as to constitutionality of measure is expressed in informed legal circles.

Out of a total of 18,818 motion picture theatres now in operation in the U. S., 16,421 are operated by independents, thus indicating that the producers are interested in or control outright 2,397 houses. Of the 16,421 independent houses, 3,910 are part of small independent circuits.

NOTES *from the* SUPPLY FIELD

★

NEW CHANGE-OVER WARNING UNIT BY CRAFT MEMBER

A new change-over signal, tradenamed the Can't Scratch Film End Warning, has been developed and marketed by R. L. Tanson, member of I. A. Local 169 of Oakland, Calif. The warning is a governor-type which is controlled by the variation in speed of the upper magazine shaft: the increasing speed opens the governor, which closes an electrical contact, thus sounding the warning. The warning is mounted on the arm of the upper magazine and is propelled by a friction disk attached to the end of the upper magazine shaft.

The warning in no way comes in contact with the film itself, thus preventing print damage.

Simple Switching Arrangement

The switch used is a single-pole, double-throw, mounted conveniently between projectors. When the warning signal comes in on one machine it is shut off by throwing the switch, which is then ready for use on No. 2 machine. Adjustment for time-length of the signal is easily made by a small set screw. This unit is extremely simple in construction and operation, requires no maintenance trouble or expense, and is moderately priced. Details available upon application to Can't Scratch Film End Warning Co., 243 Oakland Ave., Oakland, Calif.

PROJECTIONIST OSCILLOSCOPE

An oscilloscope designed especially for projection room test operations has been introduced by the Sundt Engineering Co., 4260 Lincoln Ave., Chicago. This is the first simple and effective test unit for projection work made at a reasonable cost. Daily tests are possible, with the sound being visible at a glance. Complete details from the company. (This unit was described in I. P. for Nov., 1936, p. 17.)

AMERICAN EQUIPMENT EXPORTS SOARED IN 1936

During 1936 motion picture equipment exports showed an upward trend, a total of 1,454 projectors of 35 mm. standard gauge, with a value of $383,078, being exported to all markets, as compared with 1,243 projectors valued at $353,216 during 1935. 16 mm. gauge projector exports to all markets during 1936 show a remarkable increase of over 5,000 projectors. During 1936, 7,388 such projectors, valued at $304,278, were exported, as against 1,981 projectors valued at $124,933 during 1935.

Sound motion picture equipment exports during 1936 have increased over $600,000. During this period $2,105,288 worth of American motion picture reproducing and recording equipment was exported to all foreign markets, as against $1,482,281 worth during the year 1935. The foregoing data obtained from Nat Golden of the U. S. Dept. of Commerce.

NEW PRECISION RESISTORS

Precision resistors in handy plug-in form and of selected ohmages permitting of various combinations for any total resistance value, are now offered by Clarostat Mfg. Co., 285 North 6th St., Brooklyn, N. Y. These plug-in resistors were originally developed for use in resistance bridges and other laboratory test equipment. Housed in a standard 4-prong tube base, these units are available in values of 1 to 10,000 ohms, with any accuracy up to 1/10th of 1 per cent. Due to the ingenious design, they are quite inexpensive.

RCA PHOTOPHONE PROGRESS

Reports of progress from RCA Photophone headquarters: RKO-Radio Pictures has renewed its RCA recording license for ten more years. Distribution charges will be based on theatre running time of prints, rather than on an arbitrary cost per reel. Pathe News, Inc., will replace its present equipment with improved apparatus by RCA.

Thirteen theatres in the St. Louis area will replace their present reproducing equipment with RCA High Fidelity units. Other replacements include 12 Fox West Coast theatres, including the famous Carthay Circle and Grauman's Chinese.

JAN. 1, 1937, has come and gone without the advent of television, thus relegating to the junk heap 1,917 predictions about its around-the-corner status. Meanwhile, RCA is quietly sawing wood and spending about $50,000 a month on its ether-picture system.

EQUIPMENT BUSINESS BETTER

Theatre equipment supply business throughout the country was about 30 per cent better during 1936 than in 1935, and indications are that trade will continue to improve because conditions throughout the nation are generally better, according to J. E. Robin, executive secretary of the Independent Theatre Supply Dealers' Association. Robin said he did not expect a great volume of new equipment to be sold, but that business would be confined to replacements and reconditioning.

NEUMADE FILM CABINET

A circular has just been issued by Neumade Products Corp., 427 West 42nd Street, New York City, on the new Sealtite Film Cabinet. The cabinet is made up in units of 5, 6, 8, 10, and 12 sections, accommodating the 2000-ft. reel. It has several innovations among which are automatic closing of section doors, safety in chambers between sections, permanent reel carriage, and heavier gauge steel construction.

Detailed information on this cabinet is available for the asking.

B. F. SHEARER BUYS SLIPPER LOS ANGELES STORE

B. F. Shearer Co., well-known independent theatre supply dealers on the West Coast, have purchased J. Slipper & Co., Ltd., who have been in the theatre supply business in Los Angeles for 22 years. Guy Slipper is retiring from business, but his son, Glenn, will remain as assistant to Frank Harris, who is Los Angeles manager for Shearer. Complete theatre furnishings and supplies will be handled.

Complete Coast Coverage

The Shearer organization now maintains movie supply houses in Seattle, Portland, San Francisco and Los Angeles, thus effecting complete coverage of the entire West Coast area.

EYE-STRAIN: AN OCCUPATIONAL HAZARD IN PROJECTION

(*Continued from page* 24)

the retina. For example, if the eye, adjusted to a dim light, is suddenly turned toward a brilliantly-lighted object, the retina will receive too much light and will be shocked before the muscles controlling the iris can react to shut out the superabundance of light. Even in contrasts that are not strong, but frequently made, the iris is called upon to make adjustments for each change in light, the muscles of the iris become fatigued, causing the iris to respond more slowly and less perfectly. Result: eye-strain, headaches, and tired eyes.

Sudden Sharp Contrasts Harmful

When the projectionist stops to realize that similar contrasts in light in his improperly-lighted booth affect his eyes every few minutes day after day, year after year, he will know that each occurrence is an offense against Nature, and will give due consideration to correcting this condition. It is not a normal condition to be in a darkened room with the eyes momentarily relaxed and the irises practically wide open, then suddenly to focus the arc-light spot, turn on an exciter lamp and check its focus, look at the projected picture or suddenly turn on an overhead light to rewind or thread-up, *etc.*

It is not light but *darkness* that is dangerous to the eye. Prolonged exclusion from the light is known to lower the vision, and may produce serious inflammatory conditions.

The solution for overcoming eye-strain in the projection room is simple. The Projection Practice Committee of the S. M. P. E. recommends that projection room walls and doors be painted olive green to the height of the door lines, and that the walls above the door line and ceiling be a buff color. All iron work of projection ports is painted flat black. Conduit, Greenfield, *etc.*, should also be painted black. Green is a restful color to the eye. One never felt eye-strain from a ride or walk through the country on a beautiful day in Spring. The buff color overhead serves to reflect the light from properly placed ceiling fixtures. The result is that there is sufficient light for all routine duties without side wall glare, and the projected picture on the screen can be easily seen and the change-over cues spotted without strain.

Details of the Report of the Projection Practice Committee on Projection Room Planning are available through I. P. upon request.

It is quite obvious from the foregoing that in a properly lighted booth, the iris of the eye is sufficiently closed to protect the eye against a sudden increase in light; and any increase in light is of much less contrast than the same source of light striking the eye which has been in a darkened room. At no time during *proper* projection practice is there sufficient variation in light reaching the eye to cause strain.

A Typical Projection Case

Of several such cases known to the writer, there is one which is especially interesting and illustrative. The projectionist in this case had worked in the same theatre since September, 1923—about thirteen years. Due to unshielded reflected arc light from the projector apertures, his eyes began to bother him the first year he was on the job. Upon the suggestion of a friend he darkened the room as much as possible, turning on only those lights necessary to perform certain duties and then turning them off immediately afterwards. As time went on he found it increasingly difficult to look at any kind of artificial light, and

his eyes ached as badly as any toothache. He also suffered with severe headaches. He could not drive his car at night because of the headlight glare.

Four years ago he was suffering so badly he was on the verge of giving up his job. He went to an oculist who examined his eyes and fitted him with glasses. At the same time a change in projection equipment eliminated much of the glare of the arc on the aperture plates, and he felt some relief. But as time went on he continued to suffer and resorted to an eye-shade to eliminate glare from overhead lights during the short periods they were on. At all times while in the booth he wore a pair of dark (smoked) glasses, in addition to his regular glasses. He even had shields cutting off the reflected light from the front shutter of his projectors. He claimed his suffering at times was agony. He was desperate and ready to accept the advice of almost anyone.

I suggested that he work in a lighted room with inverted reflectors for indirect light. I explained to him why his eyes felt fair enough in daylight, what was occurring when he worked in a dark room, and that a properly lighted room would approach daylight or normal conditions. He claims to have felt almost immediate relief and no longer has the torturing pains in his eyes and associated headaches.

SHARON, PA., MANPOWER AND EXAMINATION LAWS SERVE AS MODEL FOR CRAFT

STILL another repercussion of the article, "Five Recent Fire Deaths Stress Poor Equipment and Lax Regulation," which appeared in I. P. for Nov., 1936, p. 15, emanates from John M. Burke, business representative of Sharon, Pa., L. U. 451. Burke, who cuts quite a swath not only in Sharon but throughout Pennsylvania, states that this article prompted him to re-examine two local ordinances which he succeeded in putting through; but he found that he liked them even better after reconsidering them.

The ordinances refer to two-men shifts and to examination of prospective projectionists. The manpower ordinance is in good shape and quite effectively blocks any chiseling by the managers. The examination ordinance, while containing questions that impose no particular strain on a prospective candidate for a license, is overall tightly drawn and exerts particular potency in its provisions for board personnel, procedure and the general section relating to the scope of the examination.

Moreover, states Burke (and this is important) his group extends their interest to equipment and insists that all theatre installations be not only efficient to insure good results but also of such type as to afford maximum safety to projectionists. As though this were not enough, Burke requests suggestions as to possible improvement of the regula-

tions relating to safety of his members. Surely, exemption from the indictment of lethargic craft leaders in the aforementioned article must be made for this aggressive leader.

The Sharon ordinances are published herein as a guide to other craft units who are striving for similar legislation:

An Ordinance, of the City of Sharon, Pennsylvania, prescribing the number and qualifications of motion picture projectionists in places where motion pictures are exhibited for the prevention of fire and panic and providing penalties for violation thereof.

Section 1. Each motion picture projector, in any theatre, place of amusement or other place within the City, where motion pictures are exhibited, shall be operated, during the time an admission is charged for such exhibition, by at least one projectionist, licensed by the City, for each projector so operated.

Section 2. Any owner, lessee, or manager of, or projectionist in, any theatre or other place where motion pictures are exhibited, upon conviction of violating any of the provisions of this ordinance before the Mayor or any Alderman of the City, shall be subject to a fine of not more than fifty ($50) dollars, to be collected as fines and penalties are now collected by law, and in default of payment shall undergo imprisonment in the City or County Jail for a period not to exceed five (5) days, and each day such machines are operated in violation of this ordinance shall constitute a separate offense.

Examination, Licensing Law

The Sharon ordinance relating to the examination and licensing of projectionists is appended hereto:

An Ordinance, of the City of Sharon, Pennsylvania, providing for the examination and licensing of certain motion picture projectionists, the establishment of an examination board and prescribing its duties.

Section 1. Wherever, under the provisions of any ordinance of the City, a motion picture operator is required to be a licensed projectionist, such license shall be issued by the Examining Board hereby created in the manner herein prescribed.

Examining Board Personnel Term

Section 2. A motion picture projectionist examining board is hereby created. The board shall consist of 3 members, who shall serve without pay, one of whom shall be a motion picture projectionist of at least 10 years' experience, one an electrician of at least 5 years' experience, and the third a resident of the City, who may be a member of Council or an employee of the City.

Section 3. The term of office of the members of the Examining Board shall be four years, or until their successors have been elected and have accepted the office, provided the term of the office of the members of th Board first chosen shall expire the first Monday of January, 1940. Members elected to fill a vacancy shall be chosen for the unexpired term.

Section 4. The Examining Board shall fix its times and place of meeting, make its rules of procedure, manner of conducting examinations, and adopt such reasonable requirements as may be necessary to properly determine the fitness and qualifications of applicants for license.

Section 5. Each applicant for license shall be the holder of a Class "A" license issued by the State of Pennsylvania, and shall file with the Examining Board an application in the form and containing the information prescribed by the Board, together with a fee of $2.50 to cover the examination and issuance of a license, if one is granted.

Specific Points Covered in Examination

Section 6. The Examining Board shall, within ten days after receipt of an application for license from a person who has complied with the provisions of Section 5, conduct an examination of the applicant covering specifically the following matters:

1. How a booth is wired for electricity, including the load of different sized wires.
2. Precautions to be used in wiring a booth.
3. Applicant should be required to operate a sound machine for the period of 1000 feet of film, with the Examining Board as observers.
4. The heat of different types of machines both in aperture and lantern.
5. A description of different safety devices used on projection machines.
6. What to do in case of fire in a booth to prevent panic in the theatre.
7. What may be done by projectionist to prevent a panic and what may be done to quiet the patrons if a fire breaks out either in booth or theatre.
8. The number of exits in, the capacity of, and the emptying time of each theatre in the City.
9. A description of the function and

loads of different generators used in theatres in the City.

10. Frequency with which safety devices should be tested.

11. How to thread up a sound head so as to cause a minimum amount of wear on the film, and how poor threading may menace safety.

Provision For Renewal of License

12. The function of the photo-electric cell and exciter lamp in the showing of motion pictures.

13. Such additional subjects as may be reasonably necessary to test the competency of the applicant to be entrusted with the care of a projectionist booth and the safety of the public.

SECTION 7. The Examining Board shall, promptly, after such examination, certify the name of the applicant, if he is to receive a license, to the City Clerk, who shall then issue such license, which license shall thereafter be renewed annually for the calendar year by the City Clerk, upon request of the holder and payment of a renewal fee of $1.00 before January 1 of each year. No renewal license shall be issued after January 1 without re-examination, unless authorized by the Examining Board.

SECTION 8. All license fees received under the provisions of this ordinance shall be for the general funds of the City.

RADIO CITY LIGHTING USES NOVEL CONTROLS

All those who visit the Radio City Music Hall for the first time, are amazed and delighted with the colored lighting and the speed and smoothness with which it dims and changes to another color and then brightens. It is all done without glare, with a soothing softness. Insensibly it creates in them a mood of relaxation and ease so that they are ready to yield themselves to the action on the stage or the screen. The lighting system is a mood-inducer and a resistance-remover.

This lighting system includes 120 automatically-controlled color screen spotlights. The color changes on the spotlights are obtained, through a Selsyn motor apparatus. Each of the 120 spotlights contain 2,000-watt, incandescent lamps and are equipped with four colors each. The changes of color are actuated from the main switchboard where all theatre lighting is controlled. Each color screen has a separate motor, a number of which are grouped together, the group driven by a Selsyn generator which is in turn operated by an induction motor.

Two special 6-cycle and 8-cycle, 25-volt generators furnish current to the induction motors so that it is possible to switch the induction motors to operate on either 4-pole, 6-cycle; 8-pole,

Academy Plans New Test Reel

The Academy of M. P. Arts & Sciences has named two committees to study and make recommendations for standardization of sound and picture projection equipment characteristics. Sections of the latest recordings from each studio will be included in a test reel for use in checking theatre reproduction. The reel is expected to be ready shortly for general distribution.

6-cycle; or 4-pole, 8-cycle; 8-pole, 8-cycle; and 4-pole, 60-cycle, thereby obtaining any one of five speeds. Then the selected speed with which the induction motor drives the Selsyn generator. The Selsyn motor will then respond in synchronism with the speed of the generator.

These 120 Selsyn-motor-operated spotlights are grouped anywhere from 4 to 14 motors on one generator. The operation of changing color is accomplished remotely from the console switchboard (the same board that controls all the lighting on the stage except the arc lamps).

Selsyn Dimmer Control

The fading or dimming out of the 36-150-ampere carbon arc spotlights is done mechanically. Each carbon arc lamp is equipped with a shutter or douser; the shutter operates in front of the light and is actuated again by a Selsyn motor through a Selsyn generator with this difference: that here the motors operating the Selsyn generators are supplied with d.c. current obtained through Thyrotron tubes, and the motor speed is varied through this tube control which can be worked simultaneously with all the other dimming.

Thus the dimming out of the 120 spotlights and the 36 carbon arc lamps can be accomplished simultaneously, resulting in a soft and soothing, almost imperceptible (if the light control man wishes), change.

THE PRESENT POSITION OF COLOR CINEMATOGRAPHY

(*Continued from page* 15)

America, France and Germany has been directed towards the problem of successful duplication of the camera original. The problem has at last been solved, though it is not yet certain whether serious efforts will be made to commercialize the system for 35 mm.

Color as seen by the eye can be formed in two ways. One can start with lights of the three primary colors and can then mix different proportions of the three lights. This is the principle upon which the processes so far described depend—the black silver deposit in the transparency controlling the amount of each primary colored light which reaches the screen. Alternatively, one can start with a single source of white light and subtract from it different portions of its constituent rays by means of dyes or pigments complementary in color to the three primary colors. In such a three-color subtractive process the image on the film must itself be colored and is built up, by superimposing in register, yellow, magenta and blue-green part images, each of which is printed from a separate negative record.

There is no simple way of producing these three-colored images in one emul-

sion layer, and accordingly the earlier forms of subtractive process were two-color approximations which relied on the fact that a film has two sides, each of which could bear one colored image. Again it was the blue filter image—which in the subtractive process is the yellow printer—which was sacrificed, but some compensation for its absence is obtained by adding some yellow to the pink printer (printed from the green filter record) making it orange, and to the blue-green (printed from the red filter record) making it green.

As a result a greater range of colors is obtainable by the two-color subtractive systems than with two-color additive. If the additive viewing (projection) filters were modified in this way, the whites would be rendered as yellow, since the two filters would no longer be complementary. It can only be done in the subtractive process, because the whites are here due to clear spaces on the positive print and derive their color from the viewing (projecting) light, which is white.

In the earlier forms of two-color subtractive processes, the negatives were printed on double-coated stock (1912). There are a large number of methods available for toning or otherwise transforming the separation positive images printed in register on either side of this material into the orange and green or blue-green two-color primaries, and the best of these still survive for the production of advertising shorts and cartoons. Although the range of hues which can be attained is greater in two-color subtractive, than in two-color additive, systems, the compromise with truthful rendering is still obvious, and were it not for the relative cheapness with which two-color subtractive films can be made, it would be safe to predict their rapid disappearance.

As it is, however, until 1933 they formed the only commercial color process to attain any sort of success with the public and probably reached their high-water mark with the Technicolor production of "Gold Diggers of Broadway," which made $4,500,000 for its backers (1930).

Because it is considerably easier and cheaper to make a first-class two-color, than even a third-rate three-color subtractive film, it is not as yet certain that the two-color film is dead. Any two-color process is inevitably a compromise, and the errors peculiar to what may be a very convenient pair of printing colors differ in kind rather than degree from those which would accompany a different choice of complementary colors. No such latitude of choice is available when a truly natural color rendering is required, since the three-part images which are then necessary must be a particular yellow, magenta and blue-green color—a much more difficult condition to satisfy.

IN 1929, Technicolor abandoned the use of images situated on opposite sides of the film for imbibition printing onto one side, thus making a three-color film a practical proposition immediately three-color separation negatives were available.

The first three-color subtractive films to be released commercially were cartoons by Disney (1932). In many re-

spects the cartoon film is an ideal medium for experimenting with color processes. The cameraman is not hampered by the lack of a perfect beam splitter camera, nor need he sacrifice quality in the negatives as he may have to do when attempting to make exposures at 16 to 24 frames a second. Cartoon separation negatives can be made in an ordinary camera as leisurely as may be convenient, each frame being separately exposed through one of the taking filters, the separation images being subsequently transferred by means of a skipping printer to three separate films.

Cartoons Comparatively Easy

Not only is the photographer's task reduced to photographing properly illuminated flat copy, whose contrast range can be kept within any required limits, but the artist can experiment on paper until he has evolved some sort of harmony out of the limited palette which may be available to him, using, if he wishes, unnaturally brilliant pigments to offset any degradation inherent in the printing process. Finally, the fact that the film *is* a cartoon enables him to evade the critical comparison with Nature that "nearly right" color processes arouse in the majority of the audience.

In the Technicolor printing process, positive prints from the original negatives are exposed through the celluloid base and so processed as to produce positive wash-off relief images in hardened gelatin.

The three relief image films are each soaked in an appropriate dyestuff and then brought in turn into intimate contact with a film of plain gelatin to which the dyestuffs transfer, building up a subtractive image by the so-called imbibition process. In present-day Technicolor a fourth grey key image is used in conjunction with the magenta, yellow and blue-green printings.

Integral Tripack Processes

Other interesting and important ways of obtaining a three-color subtractive film depend upon the production of the color part images in a multi-layer film. So far, only the Gasparcolor process has been used commercially on a 35 mm. scale (1934). Gasparcolor film is coated with three layers of emulsion, each of which is colored throughout its mass in one of the subtractive primary colors. The blue-green colored emulsion, sensitive only to blue light, is coated on one side of the film, and the yellow-colored emulsion, sensitive to red light, on the other. On top of the yellow layer is coated a magenta-colored emulsion sensitive only to blue light.

Printing is done from three separation positive films by means of appropriately colored lights. Thus, when the yellow printing separation positive is printed on to the film by means of red light, this light does not affect the top magenta, blue sensitive layer, and the image is therefore recorded only in the middle yellow-colored layer.

The magenta and blue-green printing positives are then printed by blue light onto the outer magenta and blue-green colored emulsions. The exposed film is developed and then treated with a reagent, which converts the silver image into silver-bromide—an operation which causes the dyestuff in the immediate neighborhood of the silver image to bleach. The silver halide is then fixed out, leaving a subtractive three-color positive image.

Gasparcolor multi-layer film has so far only been used as a printing material, but three layers of emulsion, one behind the other, could, if suitably sen-

sitized, be used to produce separation negatives in the camera.

Kodachrome film (1935) is built up of three such emulsion layers, but these are coated on the same side of the support and are *not colored* but only *specially sensitized.* The layer nearest the film base is panchromatic emulsion, sensitive to red light. Above this, and separated from it by a very thin coat of gelatin, is an orthochromatic emulsion sensitive to green light; while the top layer is a non-color sensitized emulsion which, therefore, responds only to blue rays and is separated from the orthochromatic layer by a clear, yellow filter coating.

When this "integral tripack" is exposed in the camera the blue rays proceeding from the subject record on the top layer, the green rays on the middle layer, while the red rays pass through both these layers and affect only the bottom emulsion. The film is developed and the negative made is dissolved away as in the normal reversal process.

Negative Materials Used

In the Kodachrome processes the camera exposure is converted into the projection positive and copies from these positives are not yet available. Accordingly, these systems are at present of interest only to the amateur. The other subtractive processes require two- or three-color separation negatives, a problem to which the ideal solution has yet to be found. The easiest way of obtaining the negatives for a two-color process is by means of a bipack.

A bipack consists of two films which travel through the camera gate either with their emulsion surfaces towards the lens or in contact face to face. The front film is semi-transparent and is sensitive only to blue and green light. The front and rear film are separated by an orange filter layer which prevents all but orange-red light from passing through to record on the rear panchromatic emulsion.

The most serious drawback to the earlier forms of bipack was the lack of definition of the rear image. This image is recorded through the fog of emulsion grains which makes up the front layer, and the consequent scattering of the transmitted light was very obvious with full exposures and in long shots where the definition of small objects was noticeably lacking.

In an attempt to improve definition, the front film has sometimes been coated on extra thin base, but register troubles due to shrinkage during processing discounted any gain in definition which might otherwise have been obtained.

Most two-color processes depend upon the blue-green image for the "drawing" of the picture, and it has, therefore, been proposed to record this image on the front film, by using for this film an emulsion which has been sensitized to red but not green light, and to back this up with an orthochromatic film which records the green record. This bipack is exposed behind a yellow filter, which removes the blue rays to which both films are, of course, sensitive, but it is, unfortunately, an appreciably slower working combination than the normal bipack.

It is possible to improve the definition of the rear image of the conventional bipack by cementing the emulsions temporarily face to face in optical contact, so eliminating one of the air surfaces, but here again practical difficulties have delayed the introduction of such material. Any standard camera can be adapted to take bipack stock, although modifications to the gate claws and magazine are essential for the production of the optimum result.

Technicolor was making commercial two-color films before bipacks were a practical proposition and they obtained their negatives in a beam-splitter camera which exposed two frames simultaneously. In this camera, the two records, being geometrically symmetrical mirror images, were capable of giving prints in register, even if the film stock shrank during processing. Although such systems may find application in the future, the negatives used for the present-day, three-color subtractive films, other than cartoons, are made in cameras specially designed for this purpose.

Color Camera Requisites

Descriptions of the Technicolor camera make it perfectly clear that the devising on paper of theoretically workable schemes for dividing up the light between three films is perhaps the simplest part of the problem, and that it is in the solution of an enormous number of minor problems quite unsuspected by patentees of such schemes that the practicability or otherwise of a three-color camera depends.

Technicolor relies on a bipack for recording two of the images, and the maximum definition obtainable by their printing process is, therefore, only to be found in their cartoon films, where, since it is unnecessary to record all three separation images simultaneously, this camera is not used and each critically sharp negative image is recorded in succession on one panchromatic film. Nevertheless, the definition in "living" Technicolor is a striking demonstration of the improvement that is possible when a modern bipack is exposed to a well-thought-out camera.

Revelation Films (British) on the other hand, use a camera designed by Brewster, in which light entering the lens is divided between three separate films by reflection from twin-bladed metal mirrors revolving at an angle to each other and to the lens. There is less light lost by this system, and, although this design necessitates a heavier construction than the Technicolor camera, it is theoretically capable of giving better definition.

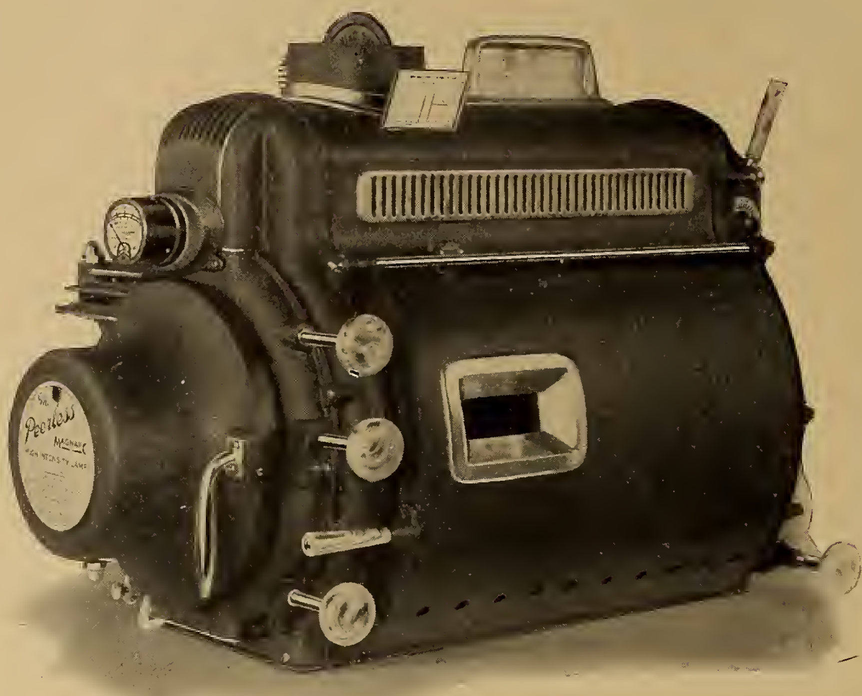
(TO BE CONTINUED)

International PROJECTIONIST

MARCH 1937 Vol. 12, No. 3

25c Copy $2 a year

THERE IS NO SUBSTITUTE FOR—



Peerless MAGNARC

TRADE MARK REG.

Whenever *quality* projection is the first requisite PEERLESS is the *only* answer.

This is one reason why there are more PEERLESS MAGNARCS in use than the combined total of all other makes, and also why its leadership increases constantly.

"THE FINEST PROJECTOR ARC LAMP EVER BUILT"

SOLD BY

NATIONAL THEATRE SUPPLY CO.

MANUFACTURED BY

J. E. McAULEY MFG. CO.

552-554 WEST ADAMS ST. CHICAGO, ILLINOIS, U. S. A.

THE WORLD'S LARGEST PRODUCER OF PROJECTOR ARC LAMPS

International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 12 MARCH 1937 *Number 3*

Published Monthly by

JAMES J. FINN PUBLISHING CORPORATION

580 FIFTH AVENUE, NEW YORK, N. Y.

Circulation Manager, RUTH ENTRACHT

SUBSCRIPTION REPRESENTATIVES

AUSTRALIA: McGills, 183 Elizabeth St., Melbourne
NEW ZEALAND: Te Aro Book Depot, Ltd., 64 Courtenay Place Wellington
ENGLAND AND DOMINIONS: Wm. Dawson & Sons, Ltd., Pilgrim St., London, E. C. 4.

YEARLY SUBSCRIPTION: United States and possessions, $2 (two years, $3); Canada and foreign countries, $2.50. Single copies, 25 cents. Changes of address should be submitted two weeks in advance of publication date to insure receipt of current issue. Entered as second-class matter February 8, 1932, at the Post Office at New York, N. Y. under the act of March 3, 1879.

MONTHLY CHAT

INSURANCE companies say "No" at the "present time" to any reduction in premium for projectionists. Most important among several well-founded reasons for the negative answer is the almost universal lack of adequate ventilation facilities in projection rooms. Danger from film fires, under existing conditions, was the least important factor. Clearly a case of it being not the heat but the humidity.

SERIOUSLY, though, the ever-present danger of a projection room film fire has thrust into the background ventilation, adequate sanitary provisions and other important considerations. Room ventilation, we think, merits almost as much attention as the question of wages and hours of work. Some of the boys now making enforced stays in Arizona and Colorado would gladly have settled for a film fire—in preference to the fire ranging within.

PHRASE-MAKING has always been one of the major concerns of the motion picture industry. Keenly aware of its many contributions to philology, we still would like a detailed explanation of the precise meaning of "three-dimensional sound reproduction," now being ballyhooed by the electrics.

THE president of the M.P.T.O.A. decries current organizing effort among exchange workers. "It is unfortunate and unworkable," he says. Considering exchange labor practices as outlined elsewhere herein, we agree that it is "unfortunate"—but not for the workers.

DESPITE the known glaring deficiencies of the projection optical system, attempts to solve the problems presented by color film reproduction will follow the conventional pattern of larger carbons, higher amperages and the addition of a host of attachments to existing mechanisms. As with sound pictures, the total bill will be paid almost entirely from the industry's share of receipts. A program of two features, a short and a newsreel, the usual thing now, indicates that this business doesn't have enough sense to come in out of the rain.

THE wave of requests from individuals and organizations for extra copies of the tube characteristics charts (RCA and W. E. types) caught us unprepared and unable to service everybody promptly. A little patience, please. These charts were prepared for you and we want you to have them.

JUST to keep abreast of the record: the Federal Communications Commission reports that the much-advertised glamour of "television this year" boils down simply to a set of difficult technical problems requiring many months for solution.

INTERNATIONAL PROJECTIONIST

VOLUME XII NUMBER 3

MARCH 1937

THE SIMPLEX SHUTTER DRIVE AND ITS ADJUSTMENT

By *A. C. SCHROEDER*

MEMBER, PROJECTIONIST LOCAL UNION 150, LOS ANGELES, CALIFORNIA

IN THE old days the shutter was adjusted at the hub to a position considered by the projectionist to be correct; then the picture would be thrown on the screen, and if there were travel-ghost, it was necessary to stop, reset the shutter, and try again. When the master blade was cut close, this procedure usually had to be repeated many times before the desired result was obtained.

Now we have the adjustment arranged so that it corrects travel-ghost while the machine is in motion, and the method of doing this involves some interesting problems with which many projectionists are not familiar.

The existence of these problems is probably the reason for the introduction of the shutter adjustment—at least they were the cause of this development at that early period, when the Simplex was first introduced. There is no question but that eventually we would have had some such arrangement anyway.

The first trouble is that the picture must be framed at various times, so some device is incorporated in the mechanism to accomplish this. But the aperture hole and the lens must remain stationary, and, as mentioned previously in these articles on shutters, for best results the shutter shaft must also remain in the same position. Now, when changing the position of one rotating part, some other rotating member (the shutter shaft) remains in one position, and these

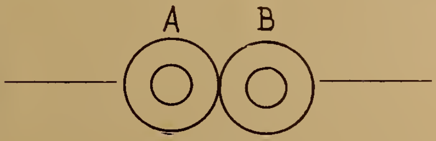


FIGURE 1

two parts must be connected by a train of gears so that they will stay in synchronism—and the solution is not always simple.

Camshaft Must Be Considered

Perhaps you are thinking that the position of the Simplex movement is not changed, that it is only turned through a portion of a revolution when the picture is framed; but that is not the whole story. The flywheel shaft and the intermittent shaft *do* stay in the same position; but there is a little matter of a camshaft situated within the case. This camshaft moves through a portion of a circle.

In Fig. 1 we see two circles which represent the two gears in the intermittent case. The gear A is part of the shaft, on the other end of which is mounted the flywheel. The gear B is on the camshaft. While the intermittent case revolves during framing, the flywheel shaft, being on the same center on which the case turns, does not move. The case revolves as though it were pivoted on the flywheel shaft. The flywheel does revolve sometimes as we frame, but it can be held so that it does not turn, and then the gear A also remains stationary.

The gear B is mounted off-center, so to speak, and, while framing, its shaft moves around a circle centered on the shaft of gear A. Gear A being held in one position, gear B must roll around A. Suppose that the pin in the cam

had been just at the verge of entering the slot in the star wheel before we moved the framer. Because the gear B rolled around gear A, the cam also turned, and the pin entered the slot and moved the star wheel, which in turn

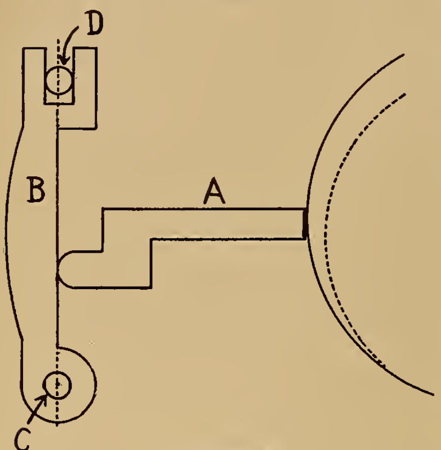


FIGURE 2

moved the intermittent sprocket. Thus, by moving the framer we started moving the film, while the rest of the machine was not moved. Because we held the flywheel, the shutter remained in the same position, so the total effect has been to throw the shutter out of time. The film started moving, but the shutter is still at the verge of entering the light beam, whereas it should be quite an appreciable distance into the beam.

Note that the relative position of the cam and the shutter has been changed; this will be so whether the machine is idle or projecting a picture.

Here again, this is not the whole story. We have neglected to mention a corrective device. One edge of the ring in which the intermittent case is mounted is not concentric, but takes the form of a cam, against which a plunger is forced by a spring. In Fig. 2 we see what this part of the mechanism looks like. The dotted portion of a circle is the concentric part of the ring in which the movement turns. The solid part is the cam formed on this ring, and moves the part A to the left when the picture is framed one way, and allows A to move to the right when framed the other.

The arm B is pivoted on the pin C, and this arm is forced to follow the movement of A. At the lower end of B is a spring which forces B to the right, thus keeping A in contact with the cam. The pin D is not part of B, but slides in the slot at the end of B. D is fastened into a part also having a sort of a slot, and moves a small spiral gear back and forth on its shaft during the framing operation. This is the gear that can be seen to slide endwise when the framer is moved, and drives that which is the shutter shaft on the old-style heads having the shutter before the lens.

By holding the flywheel and moving the framer, this gear will not be able to rotate; but in sliding along the shaft it will force the gear meshed with it to turn, because they have spirally-cut teeth. By this means the shutter is advanced just enough to offset the movement of the camshaft in the case.

Notice the shape of B in Fig. 2. This could have been made as in Fig. 3, which is simpler, and one would naturally think it would be made this way. The dotted lines in Fig. 2 are a continuation of the straight portion of the right edge of B, showing that the center of pin D and the center of pin C are exactly in line with that part of A where it touches B. No matter to what position the framer is moved, the point where A touches B is always exactly in line with the center of the pins C and D.

This would not be so in Fig. 3. There is a certain distance between a line drawn from the centers of these pins and the point where A would touch the arm; but this is not the bad feature, which is the fact that this distance varies when the arm is in different positions, thus causing the correcting movement of the shutter to be wrong.

Corrections Complicate Design

This detail could have been corrected, of course, by changing the shape of the cam or by changing the shape of the right edge of arm B, in Fig. 3. These two corrective measures introduce complications in laying out the design and in the machining processes; but even this is not so bad as the presence of another disturbing influence. The pin C is mounted in a sliding block, and it is this block that is moved when the shutter is adjusted. The corrections on the cam and on the shape of the arm can be made only for one position of the pin C. When C is moved to another position, the shape of the cam must

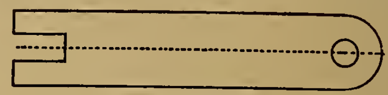


FIGURE 3

be changed. With B made as shown in Fig. 2, none of these troubles is encountered. With a certain movement of the framer the shutter is always moved the right distance to bring it back in time.

Just a final word about the adjustment. When the shutter is adjusted, the knob that is turned is on a shaft which either slides the block on which C is mounted or it is coupled to another shaft at right angles to it, which moves this block. As C is moved, the arm B pivots around the end of A as a center, causing the upper end to move in the opposite direction and again it carries the small gear, which in turn rotates the shutter. The maximum movement of C is probably about 3/16 of an inch, and for any position of C the shutter is correctly adjusted when the framer is moved.

NEBRASKA LABOR BILL KILLED

A bill requiring the installation of lavoratories in all motion picture theatre projection rooms has been killed in the Nebraska Legislature. Nebraska labor has been waging a hard fight to improve room conditions in theatres.

Projection room of Sumter (So. Carolina) Theatre includes two Brenkert Enarcs on Motiograph projectors, a Reelite and small spot. A model small-theatre room in every respect, particularly in size, finish and accessory appointments. Installation by Wil-Kin Theatre Supply Corp., Atlanta, Ga.

WHAT IS THE PRESENT POSITION OF COLOR CINEMATOGRAPHY?

By *D. A. SPENCER, Ph. D.*

The Presidential Address Before the Royal Photographic Society of Great Britain

II

This concluding article in this series on color in motion pictures cites the relative advantages and disadvantages of the various systems. Numerous projection problems complicate the color film situation, necessitating expensive and cumbersome attachments. The use of newsreels for color film experiment is urged. The producers' dilemma: will color pay its way at the box-office? Color for color's sake is ruled out. Doubt is expressed that the industry can not afford to pay the bill for color.

THE future which may lie in front of the various processes cannot be estimated on the basis of our present knowledge. In additive processes the color rendering can be more accurate than in subtractive systems. This is because no known magenta or blue-green coloring matter fulfils the theoretical requirements of subtractive processes as closely as do the available projection filter colors those of additive systems. Generally speaking, additive materials are cheaper and easier to process both at the negative and at the positive stage. Their big disadvantage is that they require considerably more light for successful projection than do subtractive films.

In Francita the same amount of negative material is used as for black-and-white, namely, standard panchromatic stock. On the other hand, in projection a special optical unit must be added to the standard projector, and owing to the fact that the image is built up on the screen from three positive originals, each 8.5 x 11 cm. in area, the definition can hardly be better than that attainable from a 16 mm. film enlarged on a similar scale.

Amazing improvement has taken place in the last few years in the direction of reducing grain size, and there is no reason to assume that progress in this direction has reached its limit. It is claimed that the other disadvantage of such multiple-image processes, namely, possibility that film shrinkage will put the film permanently out of register, has been overcome by the improvement in the film base itself, coupled with the use in the projection unit of the supplementary adjustable lens which enables the relative position of the images on the film to be varied and so counteract the effect of shrinkage.

The lenticular processes also have the advantage of requiring no more film, as such, than monochrome. Moreover, it is again a normal panchromatic emulsion, though the film base is embossed during the manufacture with the lenticular elements. Such embossed film stock need not necessarily cost appreciably more than ordinary monochrome material. Optical considerations demand, however, that the film be exposed at one aperture, and as exposure considerations dictate that this be as big as possible, depth of focus is limited, and there is slight parallax on out-of-focus portions of the picture.

Projection Optical Defects

On projection, in addition to the light loss consequent on the fact that in all additive processes two-thirds of the available light cannot be used, there is also in lenticular systems light loss due to scatter and the reduction of effective aperture of the lens by the opaque margins of the banded filter. This, and the critical relationship which must be maintained between the various components of the projection optical system, is, perhaps, the most serious drawback to lenticular processes, though there is also the risk that film shrinkage may throw the film permanently out of color balance.

In Dufaycolor there is less light loss on projection than in either of the other two additive systems, since the whole area of the projection lens is transmitting light to the screen, while any shrinkage of the print is of no more importance than it is in monochrome. Moreover, it is exposed in an ordinary camera with no limitations as to the focal length of the lens used, and projected in a normal projector exactly as for black-and-white.

The disadvantages of Dufaycolor in its present form are that, even though less light is necessary for projection than with other additive systems, it yet requires more light than is available in the smaller theatres, if it is to be seen at its best. There is also the question as to the visibility of the screen pattern; but in this connection the new negative-positive process has gone far towards removing objectionable features of this pattern, and matters could be further improved by making the individual elements slightly smaller. It is not now certain whether, with the new method of processing, this reduction will be necessary for the pattern to escape our conscious attention.

The subtractive processes start with the considerable advantage that no more light is required for their projection than for monochrome. The whites in a subtractive process are areas of clear gelatin just as they are in black-and-white; and an additive process which is to show a color rendering of similar saturation and brilliance requires theoretically three times as much light on the gate or a bigger aperture projection lens. Subtractive color film is, moreover, projected exactly as black-and-white, an advantage which, of the additive processes available, only Dufaycolor shares.

Positive Print Costs

Against this must be set the greater difficulty of obtaining suitable negatives and of making positive prints therefrom. At the moment only Technicolor and Brewster have really efficient three-color cameras, though any subtractive process could, of course, produce three-color cartoons, and all of them, via a bipack, can produce good two-color negatives. Given a simple negative process, however, the higher cost of the positive prints remains a drawback. Only in the case of Technicolor is there a suggestion that a near approach to black-and-white cost may be possible, given a sufficiently large output, but so many factors enter into costing any process of this type, *that arguments based on the cheapness of the raw material are apt to be misleading.*

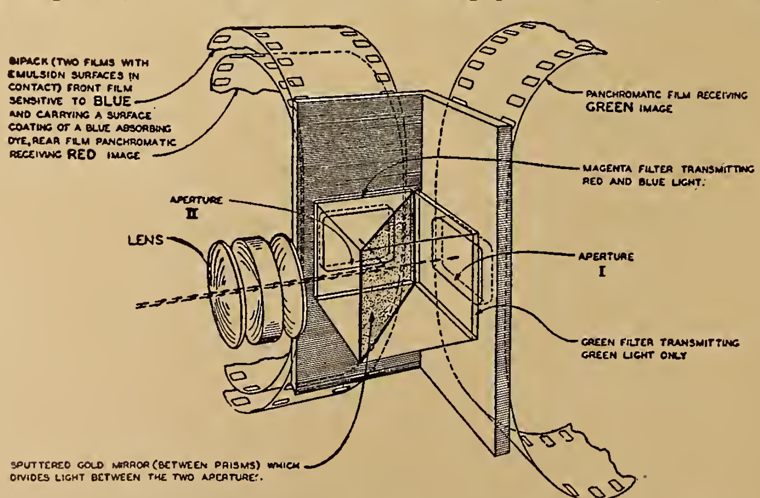
Finally, it is much more difficult in a subtractive than in an additive process to maintain that exact color balance upon which the beauty of a color photograph depends. In Gasparcolor, Kodachrome and the new Agfa process any alteration in the relative sensitivity of the three separate emulsion layers be-

fore exposure, of degree of latent image loss after exposure or alteration in the coating weight during manufacture, will affect the final color balance.

Kodak and Agfa fortunately can carry out the large-scale experiments upon which solutions of these problems will probably depend, while at the same time finding a market for their semi-experimental material. Kodachrome, for example, is now so popular with the amateur that last year 40 per cent of Kodak's American sale of sub-standard film consisted of Kodachrome. Those who have had any considerable experience of Kodachrome in this form know that color balance does, in fact, vary slightly from reel to reel and that the differences cannot always be attributed to errors in exposure. These differences are of negligible importance to the amateur, but they would be a more serious matter in a professional film. The fact that in the short time Kodachrome has been on the market there has been considerable improvement in its quality is an indication that when and if it is used for 35 mm., this problem will have been solved.

Since Gasparcolor film is used only as a printing material, its users presumably need only contend with the coating weight problem, since immediately before printing they can make tests to determine any alteration in printing ratios which other variables may necessitate. In the last few months they have processed over one million feet of their color film in England alone, and you are now familiar with the brilliant results obtainable by Gasparcolor in advertising shorts made on this material.

Technicolor, on the other hand, has had a long start, and the accumulated experience will serve it in good stead for some time to come. It, moreover, has the advantage that, although the making of the printing cliches is an additional operation which adds materially to the cost of a single print, the actual positive material itself upon which the prints are produced by imbibition is little more than a layer of plain gelatin on film, and the large number of release prints required by professional production should be cheaper to produce on such material than on the special multi-layer films required by the newer processes.



Schematic of the arrangement of optical parts and films in Technicolor 3-color process camera, wherein three records are obtained through two apertures

Apart from difficulties peculiar to each process, there are some which are common to all color systems. Considerably more light is necessary for the exposure of the original negatives—the additional amount being approximately the same for both additive and subtractive systems. The lenticular processes are the most expensive in this respect, but the additional amount required is of the same order for the other processes—whether additive or subtractive. Appreciable improvement in working speed is dependent upon research into photographic emulsion making, rather than color processes as such, and any gain will, therefore, probably be equally applicable to all processes. This point is worth stressing, because one is continually hearing of new systems which are said to require at the negative stage "much less light than any known system." When, as is usually the case, this gain is at the expense of the saturation of color rendering, it represents a step available to any process whose sponsors believe that robbing Peter will satisfy Paul.

It is true that there are, at the moment, differences in the working speed of the various forms of negative material, but they are such as to provide a "talking point" rather than a material contribution to this aspect of the problem. As it is, the additional light required is a serious problem, and it is interesting to reflect that, whereas with the introduction of sound, film-making was driven into the studios, and Hollywood, because of the curse of Babel, began to lose its monopoly grip on the industry, the reliable Californian sunshine may, at first, tip the scales in favor of America again when color production starts in earnest.

All the disadvantages thus far cited are capable of solution. None of the processes is up against the stone wall of the demonstrably impossible or the knowledge that its ultimate achievement has already been surpassed by processes based on different principles; and in view of the intensive nature of current research, it would indeed be foolish to prophesy, even generally. I cannot, however, ignore the future; what we want rather than prophecy is a program.

Influence of Color Cartoons

It is, perhaps, significant that Disney's *Silly Symphonies* are the only color films which have received universal approval. How much of their success is due to the fact that cartoons are the only films so far produced in which the color is completely under the control of the producer, and how much to Disney's genius, we do not know. It is at least arguable that those critics who are of the opinion that the only real future for color kinematography lies in the non-realistic cartoon are merely paying a tribute to the high level of technical quality which has been attained in that medium, rather than making out a case against the general use of color, and we must be careful not to draw sweeping conclusions about the future of color on the basis of a justifiable distaste for imperfect color handled in the florid manner which is now so usual.

The simplest method of evaluation is to imagine that color photography had been invented before monochrome photography, in which case we should by now be so used to color, and understand so much better how to handle it, that the discovery and substitution of monochrome would seem a retrograde step, except, perhaps, for special effects. To complete this inverted picture it is necessary to assume that the monochrome process is of a photographic quality equivalent to the average news films—for this is the level of quality which, in my opinion, color has attained.

The critics would then almost certainly protest that we are not color-blind, and that the suggestion that this new-fangled monochrome would eventually oust the familiar color film was ridiculous—that, at the most it should only be used for special effects, such as the line-drawing cartoons of Disney!

Looked at in this way the answer to the question, "Do we want color?" is "Naturally"—though we are not neces-

sarily going to prefer the color productions of the next few years to monochrome. The latter has had an excellent start, and 30 years of "trying it on the dog" has evolved a technique of presentation admirably suited to the black-and-white medium. Producers, cameramen and directors have grown up in a black-and-white universe, and to take their product in its present form and color it can hardly be more successful aesthetically than would be the fitting of dialogue to a silent film. The moment sound released the film from the frustration of the sub-title, the film began to alter, and one has only to see a modern motion picture without sound to realize just how much the film's present architecture is conditioned by its appeal to *both* eye and ear.

Early sound films, judged by present standards, were intolerable: the films themselves were little more than photographed stage plays in which action was slowed down to permit of a spate of talk and noise. Many people firmly believed, therefore, that sound pictures would prove a short-lived boom. On the other hand, the re-orientation of ideas and production methods which rapidly followed was easier to bring about than will be the reorganization demanded by color, and analogies to the "talkie revolution" are, beyond a certain point, misleading. A slight distortion in the reproduction of sound is not necessarily fatal to our enjoyment. The fact that an actor's voice as reproduced may be markedly different in timbre from his actual voice will pass unnoticed; but equivalent distortion of flesh-tone color rendering might turn this to an unforgivable green.

Color kinematography has no industry equivalent to radio to which it can turn for ready-made solutions of its problems. It must pull itself up by its own boot laces. Fortunately, the introduction of sound dealt the first serious blow at those empirical methods of working, which color will, of necessity, banish entirely, but a realization that empirical methods are even more disastrous in color production than they are in sound is hardly sufficient to ensure the rapid disappearance of black-and-white.

Color for Color's Sake Out

Even if we assume that the necessary control over the technical aspects is already attainable, there are many other factors which will influence the development of the color film and concerning which we have not as yet the data to discuss intelligently. That we shall continue to be satisfied with color films merely for their kaleidoscopic qualities is doubtful, and so far most producers have attempted to make color run before it has really learned to walk.

It is, for example, arguable that the application of color to the story film in its present form is aesthetically a mistake, and that the fact that most story films in color to date have been "costume pieces" is a confession of technical weakness. It half hints that those responsible doubt the ability of any process to deal as yet with subtleties and have, therefore, played for safety by clothing the actors in every color of the spectrum so that the eye may be stunned into a realization that theirs really is an all-color film, and be blinded by the undeniable color range of the actors' clothes to the peculiarities of his complexions!

I may be wrong here—available processes possibly are capable of dealing with subtleties—but the backers of a color film may not be prepared to risk the additional money which color costs unless they can see with their own eyes that they are getting value for it by the color acrobatics which the film performs.

This attitude is very common with color photographic workers, as can be seen at any exhibition of still color photographs. Despite the fact that, in still photography, it is certainly possible nowadays to trap subtleties and delicacies of color on paper, glass or film, many leading photographers are still obsessed with the ability of the automatic paint box to reproduce any color, however vivid, and they prefer to run the whole gamut of the spectrum rather than work with a limited number of harmonious colors. It is not surprising, therefore, to find that art directors of color films, who in print maintain that restraint in the handling of color is essential, can yet set a tea-table with a red-and-blue checked cloth and surround it with models in yellow and purple hats wearing green and scarlet bathing costumes!

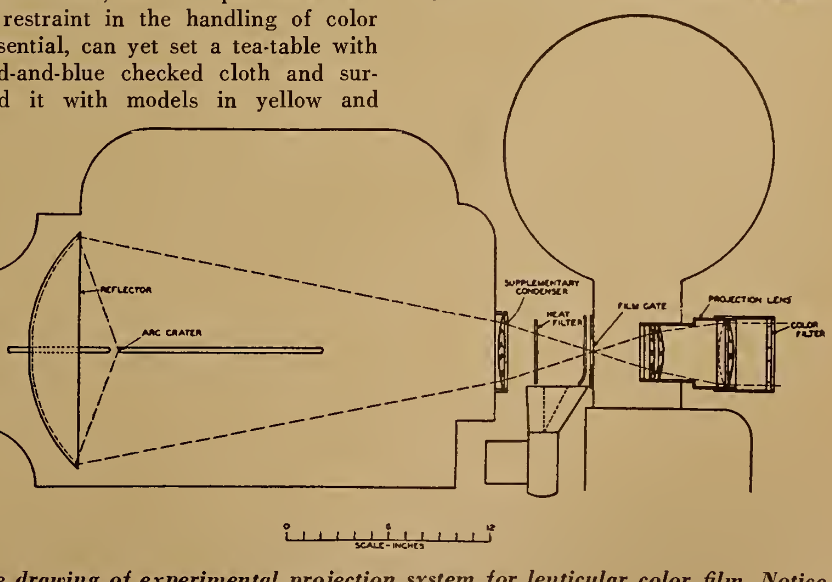
It is frequently asserted that some people have a more or less conscious antipathy to certain colors—that red irritates one group, another dislikes blue, and a third balks at yellow, and that, therefore, it is dangerous to introduce color into the film. The evidence for such statements is usually based on experiments in which colors, divorced as far as possible from associations with natural objects, are arranged in order of preference. Such preferences are surely of minor importance, insofar as they may apply to color in Nature.

It may be perfectly true that when a photographer spends a few hours in a room lit with red light he comes out in a less amiable frame of mind than when he went in, but this feeling is not necessarily his reaction to red in other circumstances—to a girl in a red dress, or a poppy, or a sunset, or a bloodstain. If these suggested antipathies have any significance in color cinematography, they are presumably no more serious than they are on the stage. A plea that black-and-white clothed artists, using charcoal instead of rouge, should appear in black-and-white settings would be dismissed as ridiculous if put forward on such grounds.

Even more specific are those lists in which the emotional possibilities of color are summed up in such statements as that red is a warm color which suggests danger, anger or sin, and yellow a joyous color which suggests wealth and gaiety. Such suggestions are on a par with the statement that to make a character convey impression of being a villain he should be sallow, have a black-waxed moustache and preferably be called Sir Jasper.

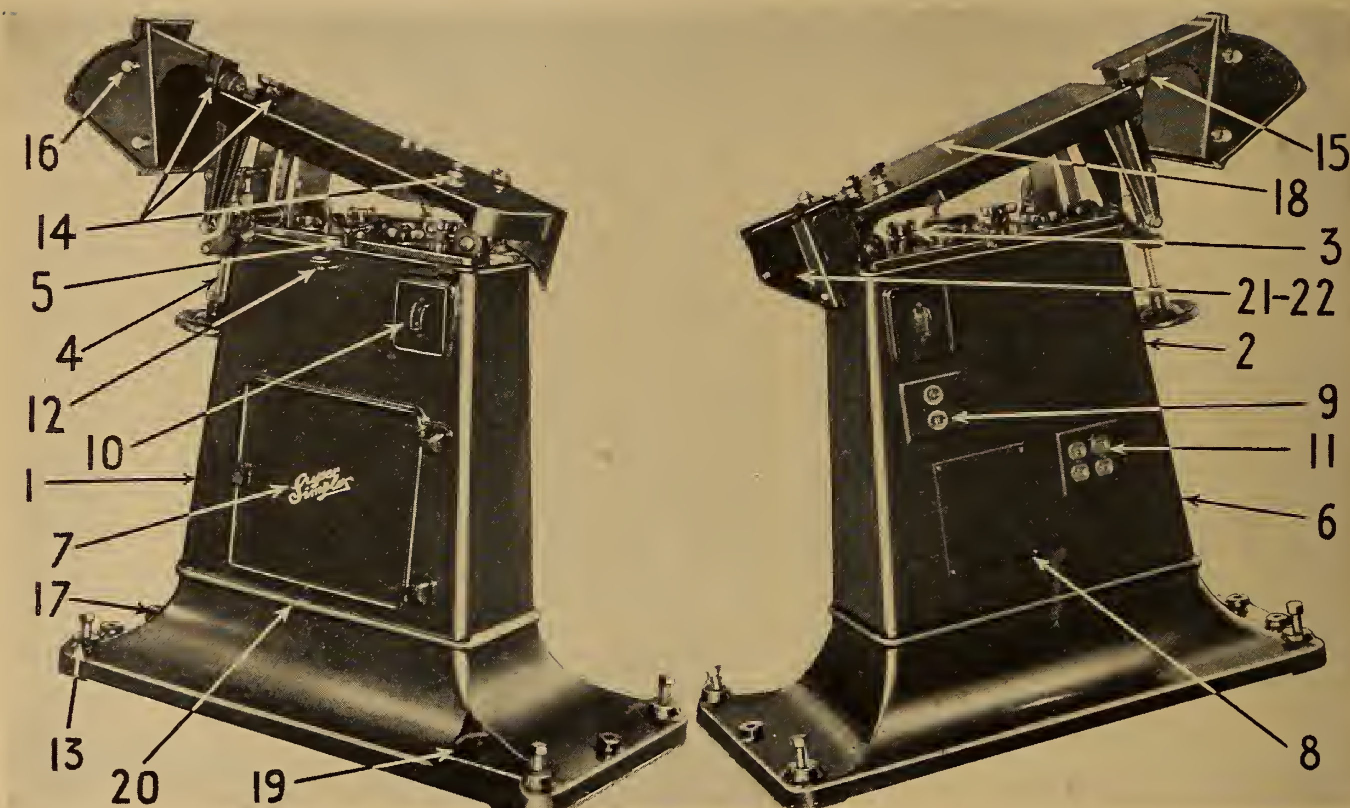
Indeed, they are not so helpful, since a yellow which to some may suggest the dawn of hope may recall to others the curate's egg; the Royal Yellow of the Mandarin is also the color of the lemon. Even if it were true that the

(*Continued on page* 31)



Scale drawing of experimental projection system for lenticular color film. Notice extensive changes required.

The New *Super-Simplex* Pedestal



1. Symmetrical and harmonious with projector, soundhead and lamphouse in design and finish.

2. Provides excellent balance for the heavy-duty equipment it must support: especially large, heavy lamphouses; heavy mechanisms, long, heavy soundheads, and 2000-foot reels.

3. Pivot point located back under lamphouse to insure proper balance and minimum strain, especially where soundheads with motors mounted on front are employed.

4. Simple tilting device employing short lead screw with bracket provided with three convenient points for a horizontal rod suspension, permitting easy tilting between minus 3 and plus 33 degrees.

5. Lateral adjustment permits 3½-degree horizontal angle adjustment from either side to simplify installation and insure proper centering of picture at all times.

6. Weight of unit provides a steadiness for the entire equipment heretofore unobtainable.

7. Spacious internal compartment provided into which all electrical connections may be brought, thus eliminating the need for a network of wires and cables distributed around the projector in an unsightly manner.

8. Where not convenient to bring up conduit through floor into compartment, plate is provided in non-operating side permitting bringing in conduit from side.

9. Three-pole, twist lock receptacle for change-over device, and two-pole, twist lock receptacle for the operating motor and mounted in pedestal, permitting simple disconnection of circuit if desired.

10. Two three-way, 30-ampere switches, one on either side of pedestal, provided for motor circuit.

11. Four double-pole, standard outlet receptacles for soldering iron, work light, threading lamp, and arc lamp feed-motor if desired, provided.

12. Universal type spirit level included to permit accurate levelling of base in room upon installation.

13. Base equipped with levelling bolts fitted into solid steel cupped flanges, permitting levelling at all four corners, yet providing excellent rigidity.

14. Lamphouse support bracket includes universal joint mountings, permitting accurate alignment of any type of standard lamphouse, regardless of slight error which may exist in manufacture, by tilting upward or downward at either end, from side to side, and by raising or lowering vertically. Absolute rigidity had by tightening 4 screws.

15. Lamphouse support bracket of adequate length to properly support new style lamphouses.

16. 100-ampere, double-pole knife switch mounted in heavy cast-iron switch box, furnished for low-intensity or Suprex-type arc lamps.

17. Heavy switch supporting bracket attached to and supported by rear lower pedestal section furnished at additional charge for high-intensity arc lamp. Designed specially for "Square D" 200-ampere switch, and box not furnished.

18. Lamphouse bracket eliminated for supporting Simplex-Acme projector.

19. Flat surface on front operating corner of pedestal to which any standard change-over switch may be attached.

20. Spacers of various sizes provided for mounting between lower and upper pedestal sections to accommodate existing projection porthole construction.

21. One of four soundhead supports regularly furnished for particular soundhead attachment to be used.

22. For projection angles over approximately 20 degrees with certain soundheads, a special soundhead support is furnished.

A New Projection Tool:

THE CATHODE-RAY OSCILLOSCOPE

By *L. P. WORK*
MEMBER, PROJECTIONIST LOCAL UNION 601

FIGURE 1
Observing film adjustments with the oscilloscope

OLD devices in new dress come to the projectionist's attention from time to time. One of the most fascinating and fertile of new applications is the cathode-ray tube. The modern cathode-ray oscilloscope is a tool which opens new vistas by means of which we can *actually see* what is going on in the sound-picture equipment.

It is possible to observe this high-speed electrical phenomena by utilizing the action of a stream of electrons impinging upon a fluorescent screen. Because of the characteristics of this stream of electrons—(1) the extreme speed of travel which is in the order of the speed of light, and (2) the ease of modulation of direction—we can instantaneously picture the speech currents with which we deal in our daily work.

The purpose of this brief article is to show the ways in which the oscillograph can be applied in the projection room. This is the only reward to the projectionist in studying the subject. Some understanding of the basic theory of operation is necessary with every test device, but in the case of the oscilloscope it is the *key to success or failure in its use.*

How the Device Functions

The common optical analogy used to illustrate the internal operation of the tube is shown in Fig. 2. Here we have the source of electrons represented by the light, 1; the variable aperture, A; the condensing lens, C; the "objective" lens, O, and the luminous screen at S. The functioning of this optical scheme should be self-evident to the alert projectionist. In Fig. 3 is given a schematic of the electron-gun arrangement employed in a standard cathode-ray tube. The source of electrons is the cathode, C, which is heated by the filament, F, in the same manner that the heater-cathode arrangement in the common radio tube operates. The cathode tends to emit electrons and supplies the electron stream which passes through the aperture toward the first anode, M, which carries a positive potential.

At this point we should bear in mind the behavior of electrons in motion. They are negatively-charged particles and are repelled by the presence of a negative potential, or field, and are attracted or accelerated by a positive potential, or field. It is this characteristic which makes possible the cathode-ray oscillograph.

It can be seen that the potential applied to the grid controls the number of electrons drawn from the cathode and thus made available to pass through the aperture, thereby providing a brilliancy control for the "trace" on the screen. After passing through the grid aperture the electrons transverse the field of the first anode, M, which acts in a similar manner as the condensing lens of our optical analogy. Here the beam of electrons is further "straightened" or concentrated so as to focus at the screen distance at S. This focusing effect is obtained by varying the positive potential applied to the anode through a potentiometer. Next to the right is located a second tubular anode, N. This anode carries a still higher positive potential, thereby giving the electron stream the necessary velocity to luminate the stream at the point of impact.

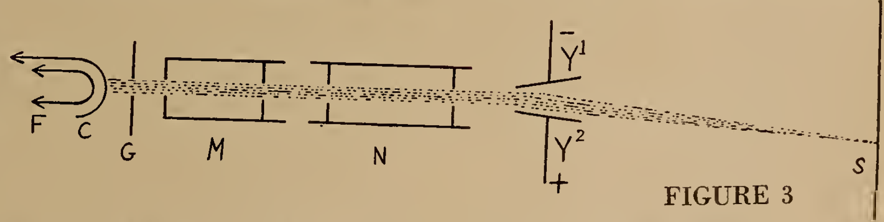


FIGURE 3

After passing through the second anode, N, the electron stream transverses the space between the deflecting plates, Y^1 and Y^2, and herein lies the useful function of the cathode-ray tube. Any test potential applied to these deflecting plates will cause a bending of the stream toward the positive plate and away from the negative plate. Furthermore, this action takes place without any observable inertia, or time lag, on the part of the electron stream and is done with but infinitesimal current between the deflecting plates, *i.e.*, the deflection is purely a function of applied potential.

Forming the Screen Pattern

We can, therefore, apply alternating voltages from zero frequency up to several hundred thousand cycles per second and obtain a faithful trace with the electron beam. But this trace will be merely a vertical line on the "Y" axis, the length of which is proportional to twice the applied peak a.c. voltage.

A second set of deflecting plates is

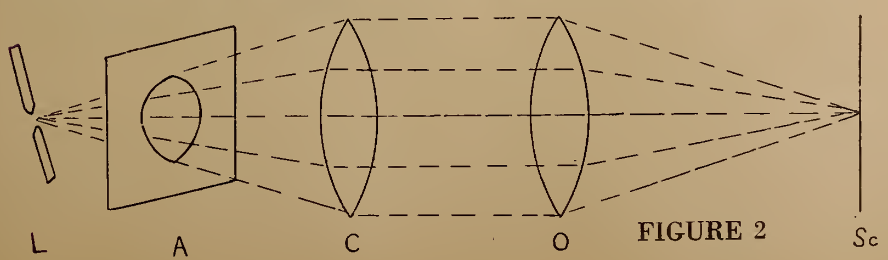


FIGURE 2

mounted in the horizontal order and deflection in a horizontal line, or "X" axis, is thus obtained. As previously stated, an a.c. voltage applied to either vertical or horizontal plates alone will produce

FIGURE 4

either a vertical or horizontal line, as the case may be. But when we apply an a.c. voltage simultaneously to *both* sets of plates, a figure or pattern results on the luminous screen.

Advancing from this, our starting point in the interpretation of a.c. phenomena, the projectionist will find an almost inexhaustible field to explore and study.

It is obvious that if we are to actually trace the pattern of the applied a.c. voltage, or of speech currents applied to the vertical plates, we must have some means of spreading them in a horizontal direction. Moreover, this horizontal spreading means must be in phase with the observed frequency and be submultiple, otherwise the pattern will be moving and unsatisfactory for observation.

To accomplish this desired result—that is, to spread the a.c. waves on the vertical plates—a device known as a timing oscillator is used across the horizontal plates. This oscillator must have certain unique qualities and as such is referred to as a saw-tooth, or relaxation, oscillator. Leading makes—such as RCA, Clough-Brengle, *etc.*—have this device built within the oscilloscope case.

To spread the a.c. waves (bearing in mind that speech currents, music, output from an audio oscillator, a frequency record or a test film are all of this category) we must draw the electron stream from left to right across the screen at an even rate of travel and then return it very quickly to its starting point—this being done while the stream is simultaneously modulated in a vertical direction by the vertical plates. Under these circumstances, we get a wave such as that shown in Fig. 4, which is a trace of common 60-cycle power.

An oscillator used for this spreading function must have a saw-tooth wave output as shown in Fig. 5, and it must be linear (straight line) over the portion A-B in order to have a true horizontal displacement of the applied vertical wave. By proper circuit design, a portion of the saw-tooth wave such as A-B can be utilized as a sweep-wave at any frequency to which the oscillator may be set. The RCA Type 122 oscilloscope of typical design, has served as a model in the preparation of this article, and its operation approximates closely other makes.

Other Operating Requisites

Practical needs dictate, in addition to the brilliancy and focussing controls (A) a variable gain amplifier for the input to the vertical plates (B) a similar amplifier for horizontal plates (C) the saw-tooth, or sweep, oscillator with its control (D) a lock-in or synchronizing circuit (E) a means of direct connection to both horizontal and vertical plates without their associated amplifiers (F) a means for feeding an external synchronizing voltage to the sweep (G) a fixed 60-cycle sweep, and (H) the semi-fixed controls for biasing the plates so that

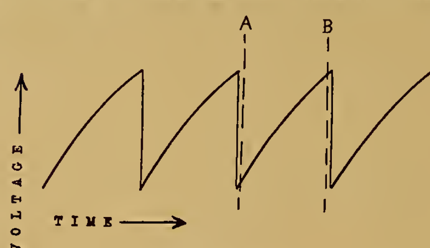


FIGURE 5

the spot position under "No Signal" condition is in the true center of the screen—this latter requisite a result of manufacturing and similar variations.

Let us consider these controls and their functioning separately.

Discussed previously was the functioning of the brilliancy, or intensity, control and the focussing control. The intensity control regulates the brightness of the trace; and the focussing control determines its fineness or definition. The former should be kept at a level satisfactory to the eye under fair external illumination; and the latter so as to produce a trace about 1/32 to 1/16 inch in width. Improper setting (usually in excess of requirements) produces a halo or a blurring of the trace.

The oscillograph should always be grounded, regardless of whether one is making preliminary adjustments or actually observing phenomena, because the electron stream is extremely sensitive to stray fields, both capacitative and magnetic. This requisite can be sharply emphasized by touching the binding post of the free vertical plate while the case is grounded: a trace can actually be made from the capacitative pick-up of the projectionist's body from the nearby power wiring.

For various reasons of design, the basic sensitivity of the cathode-ray tube commonly used (such as the RCA 906) is in the order of 75 peak volts per inch of trace or of spot displacement, either vertically or horizontally. Audio observations require a much greater sensitivity, that is, a satisfactory response to smaller input voltages, necessitating amplification of our relatively low inputs (in the order of several RMS volts) to obtain a trace of reasonable magnitude. Both vertical and horizontal amplifiers function in this capacity, for their respective plates and their gains are varied by controls usually marked "Vertical" and "Horizontal" gain.

Ordinarily the proper setting of the vertical gain should be to produce a trace about 2/3 the screen height; and the horizontal gain should be set so as to utilize the full width of the screen without tracing on the screen edge, where distortion ensues. In other words, keep the gains at a point where a good symmetrical wave is had. The frequency response of both amplifiers extends far beyond the audio spectrum, so we need fear no limitations in sound equipment tests from this standpoint.

Adjustment of Sweep Oscillator

Relative to the adjustment of the sweep oscillator, many factors must be considered. With the frequency of the observed a. c. described as *F*, then the sweep frequency must be *F*, or *F*/2, or *F*/3, *etc.*, depending upon the number of cycles desired in the picture. With the sweep frequency at *F*, we have one whole cycle in the trace; at *F*/2 we have 2 cycles, and so on. Fig. 6 illustrates an *F*/2 setting, in which the sweep rate is

FIGURE 6

one-half that of the observed frequency. The pattern is valueless in these observations when the sweep rate is greater than *F*.

It will be noted that even with the most accurate setting of the sweep fre-

quency, there is a tendency to weaving and unsteadiness. This is due to a slight drift in the sweep oscillator, as well as a change in the observed frequency, and is corrected with the use of an additional lock-in or synchronizing circuit. By feeding a part of the voltage impressed upon the vertical plates to the sweep oscillator, it will keep "in step" or "in phase" and the trace will remain "locked" on the screen. This synchronizing control should be kept at the minimum which "locks" the image.

Direct connection to the deflector plates is sometimes desired, as in cases where the input voltages are high enough to give proper deflection. Binding posts are provided to introduce an external synchronizing voltage from a separate oscillator, *etc.* This voltage will likewise "lock" the pattern so that difficulties from drifting or change of phase can be overcome. It is our belief that the use of external synchronization, when properly developed, will serve as a means for quickly identifying sources of machine noise in the sound output.

[Ed's. Note: The author of the foregoing article has by no means exhausted the topic of the cathode-ray oscilloscope. This article is intended only as a means for inducing questions and discussion by I. P. readers, comment from whom is earnestly solicited. What do *you* want to know about this new projection tool?]

S.M.P.E. NATION-WIDE THEATRE SURVEY FOR SCREEN BRIGHTNESS DATA

A NATION-WIDE survey of motion picture theatres to obtain data relating to auditorium dimensions, type of screens, projection distances and angles, light sources and other useful information is now in progress under the supervision of the Projection Practice Committee of the Society of Motion Picture Engineers. Supply dealers, service engineers and the press are cooperating in this work to the end that the survey may be as inclusive as possible.

Cooperation by the press will take the form of presentations such as this, which includes a reproduction of the official survey blank for the use of those readers who may wish to help the work along. I. P. urges its readers to use the accompanying survey form, with filled-in returns to be sent to I. P. and through it to the Committee.

Color Film Projection

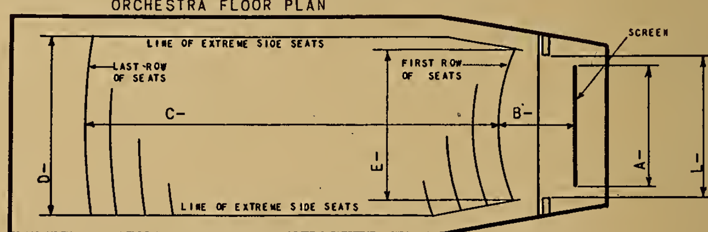
The Committee is particularly interested in establishing standards for screen brightness, which topic has received the attention of many capable technical workers during the past ten years. The problem has been complicated by an almost total lack of information relative to physical dimensions and type of projection equipment used in the various theatres, no two of which are exactly alike and therefore susceptible to the same degree to any general recommendations.

Recommendations of those technical bodies striving for improved reproduction in the theatre have been so generalized heretofore as to be of little if any practical use in other than larger houses, most of which reflect at least an effort on the part of their designers to conform to generally accepted standards. The medium- and small-size theatres have been designed on a hit-or-miss basis which precluded the possibility of even fair reproduction. This vast number of theatres is the particular target of the current survey.

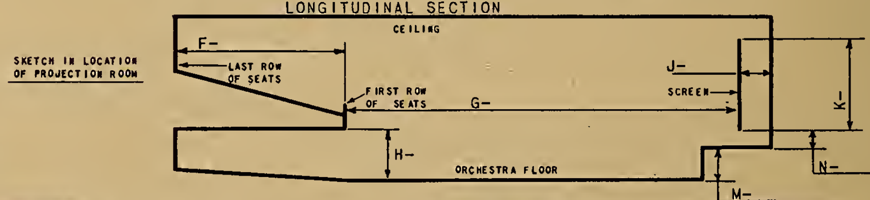
Well-informed projection people are deeply concerned over the numerous reproduction problems posed by the steadily increasing number of color motion pictures, which impose additional severe demands upon projection apparatus, particularly upon arc lamps and optics. This does not imply that black-and-white projection throughout the country is wholly satisfactory. On the contrary. But a definite improvement in reproduction standards generally can not fail to effect improvement in color film projection. Many other phases of projection will also be materially benefitted through availability of these survey data.

Collation of these data will necessarily require no little time, but Harry Rubin, Committee chairman, in appealing for prompt action in forwarding data sheets from the field, promises intensive application of his entire group to the end that recommendations based thereon be made available to theatres at the earliest possible moment. I. P. can only echo these sentiments for this obviously very worthy endeavor.

ORCHESTRA FLOOR PLAN



LONGITUDINAL SECTION



Question No. 1.
Mark on above diagrams, dimensions A,B,C,D,E,F G,H,J,K,L,M,N.
Dimension A should be White Picture WIDTH.
Dimension K should be White Picture HEIGHT
Dimension L should be Width of Proscenium Opening.

Question No. 2.
State seating capacity - A-Orchestra ______
B-Balcony ______
Total ______
Stadium seating is considered an extension of or part of orchestra level seating.

Question No. 3.
Check type of screen in use -
A- Beaded or metallic ______
B- Diffusive-mat white ______
C- Other-Describe ______

Question No. 4.
Check type of projection light source in use.
A- Low Intensity ______ Amps.
B- High Intensity "
1) High-Low (Reflector) ______ "
2) Condenser Type ______ "
3) Suprex ______ "
C- A.C. Arc ______ "

Question No. 5.
State type of current and voltage in projection room.
AC Volts ______
DC Volts ______

Question No. 6.
State focal length of projection lens ______

Question No. 7.
State angle of projection in degrees ______

Question No. 8.
State year of erection or basic alteration of theatre.

Question No. 9.
Name of theatre ______
Location ______

861 MIRROPHONIC CONTRACTS FOR W. E. IN 27 WEEKS

Erpi figures show that in 27 weeks 861 theatres in this country alone have contracted for the new Mirrophonic sound system. Of these about two thirds are completely new installations in reopened theatres, new theatres, and in theatres that had previously operated with other makes of equipment. The remaining third have modernized existing W. E. systems.

Can a Girl 'Inspect' 2 1/4 Million Frames of Picture Film a Day?

By *JAMES J. FINN*

CAN a girl inspect 2,240,000 frames of motion picture film every day for six consecutive days? Can the same girl be forced to work a few extra evenings, and possibly part of a Sunday, within the same week? Is the type of worker obtainable for these long hours for as little as $15 salary a week qualified for this important work? Is it fair to substitute for a certain schedule of work hours daily an irreducible minimum number of inspected reels?

The answer to the foregoing queries, according to prevailing standards in major producing company exchanges throughout the United States, is an emphatic "Yes". What authority is there for this statement? The very best available: this is exactly what is happening in an overwhelming majority of major company exchanges. As for the so-called independent exchanges, it is not difficult to imagine that these less affluent companies at least match, if not actually "improve" upon, the major-company system.

Complaints about mutilated film and poor inspection are nothing new, of course. For many years the exchanges have pointed to projectionists as the greatest single cause of damaged film. Projectionists have replied in kind by citing lax exchange procedure. This merry-go-round slackened only long enough to allow either side, or both, to indict Eastman or some other film company on the score of inferior stock—particularly when the high-intensity arc was making a bid for wide popularity.

Projectionist Doubling Blamed

The exchange and production people being more articulate than projectionists, and having at their disposal more effective means for publicity, the proposition finally narrowed down to where the consensus of industry opinion placed the blame for film mutilation squarely upon the projectionist. Of course, there was some scattered mention of worn and defective projection equipment, which circumstance was also laid to neglect by the projectionist—even though he be forced to operate a mechanism 20 years old and not infrequently having taped moving parts.

Projectionist insistence upon doubling single reels was cited as the greatest single reason for widespread film mutilation—despite the fact that producers, through copyright ownership of prints, could but never did make the slightest effort to enforce the single-reel standard and make effective the ban against doubling. Thus was planted the seed for the present double-reel standard, which, nutured by the Academy, the Hays office and exhibitors everywhere, came to full bloom last Sept. 1.

The double-reel was ballyhooed by distributor and theatre interests as the remedy for 85% of all film-mutilation troubles. Did not investigation reveal that practically all mutilation was traceable to damage done when the projectionist joined two single reels? Certainly. Then the answer to the whole problem was to supply double reels, of a certain definite minimum footage per mounting (remember this "minimum" footage specification), after which film mutilation problems would have been swept away at one fell swoop.

Knowing conditions in the production, exchange and theatre branches of the industry, the writer was extremely skeptical of the wonderful curative powers of the double-reel standard. These skepticisms were voiced at numerous meetings of the "best minds" of all three branches. The writer repeatedly stressed, at these meetings and in print, his doubts that the mere promulgation of a new reel standard would make more efficient the poor inspection record of the exchanges with single reels—and particularly when two single reels were to be shipped from the laboratories to the exchanges, which would then join them into one double reel. These objections were ignored as mere trivia.

The writer bided his time and watched the progress of the double reel as an alleged standard. Persistent reports from the field indicated wide dissatisfaction with exchange inspection procedure and prompted I. P. to conduct a survey of five important, large-city exchange centers. The results of this survey are appended hereto.

It so happened that the I. P. survey coincided with the first serious efforts to organize exchange workers throughout the United States. The facts adduced in I. P.'s survey tend to prove that the organizing difficulties now encountered by the exchanges are wholly a matter of their own making. Witness:

Girl Inspectors' Daily Quota

Suspecting that widespread reports of poor prints reflected lax inspection due to overwork of the girl inspectors, I. P. first sought to find out just how many hours per day or week these inspectors worked. It was established that there were no set hours of work. Each girl is given a *certain minimum quota of reels to inspect per day*—and a check is maintained as to whether she works on single or double reels! Thus, the girl inspectors face each day not a certain number of hours of work but an irreducible minimum film footage! Here are the average daily footages among the major company exchanges in the five cities surveyed:

No. 1......	58 to 70	Double Reels
No. 2......	63 to 75	" "
No. 3......	68 to 79	" "
No. 4......	72 to 85	" "
No. 5......	85 to 100	" "

One can use the foregoing figures as a basis for an interesting excursion into mathematics. Allowing for short reels and every possible advantage that might be construed as favorable to the exchange, it is evident that the major company exchanges consider that a girl has done a good day's work when she has inspected approximately 2,240,000 frames of film! That is, this is what the exchanges term "inspection". What any fair-minded person, knowing the delicate balance of projector mechanisms and the degree of heat to which these prints are subsequently subjected, would term this process is probably unprintable in a publication sent through the mails.

Even after having done such a day's work, are the girls finished? Not at all. In three of the five cities checked it was found that frequently when many prints are circulating it is not unusual to keep the girls for a couple of hours at night. For this the generous exchange managers allow each girl 50 cents! Six full days

work is the schedule of all film exchanges; yet in four cities Sunday work is a not unusual requisite.

One exchange manager came uncomfortably close to arrest for his flagrant violation of a State law which provides that women shall not be employed for more than six consecutive days. Cities located in states having no such laws naturally impose no such restrictions upon exchange managers working for the honor and glory of good old Titanic Films back in New York.

The average weekly salary for girl inspectors in all five cities checked is $15.62—not counting the munificent windfalls represented by the extra 50-cent pieces the girls pick up for a few extra hours of work in the evening or on Sundays, when required. Several of the girls selected at random by I. P. investigators for questioning as to the nature of their duties, displayed not the faintest conception of what constituted efficient film inspection. Practically all of them admitted that their only concern is that there be an uninterrupted flow of film through the inspection machine!

The quality of work produced by the exchanges throughout the United States is just what one might expect under such circumstances. This consideration leads us naturally into the workings of the alleged double-reel standard, which was ballyhooed as the means for proving projectionist responsibility for and contributary delinquency to film mutilation. We have already noted statements by the exchange inspectors themselves tending to prove their absolute unfitness for the work in hand, and the lack of any apparent effort on the part of exchanges to train them for this highly specialized endeavor.

As part of its survey, I. P. requested data as to adherence by exchanges to the double-reel standard. This information is at hand. It proves conclusively that the provisions of the double-reel standard are taken no more seriously by the exchanges than was their responsibility to enforce the single-reel standard. A group of first-run theatres which easily qualify as industry showplaces report that all reels received from exchanges are indiscriminately taken apart and spliced together again in the projection rooms, such has been past experience in the matter of exchange joinings coming apart when run through the projector. Thus is realized the oft-expressed fears of I. P. on the score of exchange reel-joining.

The revised Standard Release Print specifications provide that no single reel issuing from an exchange (except the last reel of a feature, naturally) shall be less than 1750 feet in length. The reason for this specification is apparent in the light of the fact that modern projector magazines can accommodate conveniently 3400 feet of film. Mindful of the fact that it is not always convenient or desirable to cut a print exactly at 1750 feet in length, provision was made in the specifications for latitude extending upward to 2000 feet. That is, general agreement was forthcoming that the cut would be made somewhere between these extremes—but in no event would any single reel be less than 1750 feet.

Are these specifications adhered to? Positively not. I. P. has recently checked ten consecutive feature releases to a first run, so-called de luxe, New York City theatre, which receives its new prints direct from the exchange. In nine out of ten of these features there were one or more reels of less than the minimum specification of 1750 feet. The appended figures are most interesting in this respect:

Less than 1750 feet......6
Less than 1600 " 4
Less than 1500 " 3
Less than 1400 " 1

So much for adherence to the minimum-footage provision of the S.R.P.

In other and extremely important aspects of the S.R.P. the exhibition field has ample reason for strenuous objection. Positioning of change-over marks is such as to constitute flagrant violation of S.R.P. provisions. Marks are frequently positioned on moving objects or on film of such density as to frustrate the projectionist in his efforts to effect even a fair change-over. Film density is another grievance of the exhibition field. Not only are a majority of prints too dark for good projection, but the contrast in density between reels of a given feature are so sharp as to effectively riddle the continuity of the story and to distract the audience. Apparently the technical quality of the industry's output still is being judged on the basis of Hollywood studio and New York home office band-box projection rooms.

I. P.'s survey revealed that the best all-around conditions prevail in M-G-M exchanges—that is, with respect to number of reels inspected daily by each girl, wages and extent of inspection—but this is offset somewhat by the fact that the available Metro prints run through the heaviest bookings, thus placing additional strain on each print. Fox is generally credited with having the worst prints nationally, with RKO and Universal running a close second. Columbia, with comparatively few re-

FILM MUTILATION—AS PRACTICED BY FILM EXCHANGES

A Few Film Clips and Words From H. B. Smith, Springfield, Mass.

IN VIEW of your recent articles on projection room fire precautions and inefficient exchange inspection procedure, I am sending along some patches from the 20th Century-Fox picture "Lloyds of London." These patches were taken from a print shipped to a FIRST-RUN theatre in Springfield, Mass. These patches (accompanying cut) bear the number of the reel from which they were clipped; all were at the *doubling point of each reel.*

The perforations of each of these patches are badly misaligned and show a distinct white line where scraped. (Ed.'s Note: Reproduction may not show this clearly.) The white lines are not so bad, since they come at the frame line—that is, most of the time. The misalignment is something else again, however. In addition, patch No. 7 (not shown here) had a 9½-frame gap between dialogue, plus a nice dark strip across the sound band at the patch. It is not hard to imagine what the manager said (about the projectionist, of course) when this was projected.

These patches were shown to the writer during a discussion of the *louzay* (French for rotten) condition of prints received from exchanges. The writer appropriated the patches from a projectionist of one of the largest *first-run* theatres in Western Massachusetts. The print came from the 20th Century-Fox exchange in Boston. So this is how the exchanges are observing provisions of the S.R.P., and this is the sort of service rendered to first-run houses. What sort of service can we in subsequent-run houses expect? The answer is all too evident. One can not forget the breast-beating that accompanied the introduction of the double reel. The exchanges were going to take care of everything. They are—and how!

leases, also shapes up as rendering poor inspection.

Print Condition Worse Today

It is generally agreed among projectionists that the condition of prints today, with all the reputed blessings of the longer reel, is much worse than when single reels were used. The exchanges may attribute the need for careful inspection to the deplorable condition of theatre projection plants; but this is something for the exchanges themselves to worry about, since they own the copyright on the prints and have the right to insist upon adequate projection facilities for their own property.

It is unnecessary to editorialize about the conditions uncovered in this survey: the facts are too clearly etched, the implications too sharply defined to require extended comment. This is the record of a very important activity within the world's fifth largest industry—an industry which witnesses the annual award for the best acting, the best direction, the best recording, the best editing and many other "bests," the net results of which superior endeavor, by reason of sloppy distribution and exhibition efforts, add up, or rather down, to almost zero in the final analysis. This is the industry which advertises the eye-and-ear appeal of its product in gorgeous brochures and in four-color process plates in the popular magazines—a product which not infrequently has all the appeal of a dead fish when reproduced in the theatre.

Reel Sponsors' Responsibility

There is no intent or desire here to castigate the industry for its shortcomings, for in that direction does not lie the road to improvement. The statements made here were intended as simple expressions of fact. We still would like an acceptable answer by someone in authority to the question as to whether a girl earning $15 weekly and working six, and sometimes seven, days a week (excluding evenings) can reasonably be expected to give even a perfunctory inspection to 2,240,000 frames of motion picture film daily. We should also appreciate a reassuring statement as to the joining of single reels in exchanges, and as to current practice with respect to the positioning of change-over marks and print density. Having accepted the responsibility for introducing the new double-reel standard, the Hays office and the Academy, it seems to the writer, have a definite responsibility to see to it that reasonable care is exercised in observing existing standards.

Any comment on this topic that might issue from either or both of these organizations, or from anybody else having something interesting to say thereon, will find ample space awaiting it in these pages. By the same token, projectionists who encounter persistent violations of S. R. P. provisions, and particularly with respect to short reels and improper change-over marks, are invited to avail themselves of the same facilities.

NOTES FROM THE THEATRE SUPPLY FIELD

FACSIMILI-TONE is the name of a new line of theatre sound reproducing systems now being marketed by Wholesale Radio Service Co., nationally known manufacturing and supply house. There are 14 types in the Facsimili-tone line, each complete from drive motors to loud speakers, divided into three general groups: Economy, Quality and DeLuxe systems, for use in all theatres except those running well over 3,000 seats. All except the least expensive models reproduce up to 9,000 cycles, and are readily adaptable to push-pull recording.

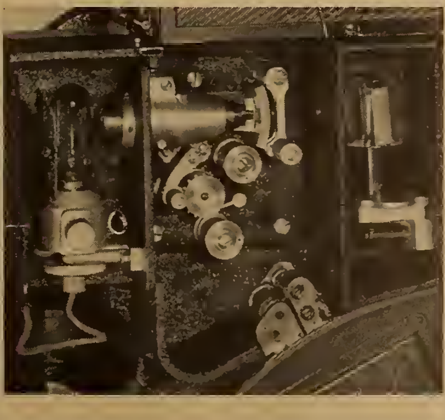
The circuits of the amplifiers have been traced in detail in these pages.* They are coded as Lafayette amplifiers model 400-A, 40 watts, and 410-A, 15 watts. The latter is used in the Economy Systems, the former in the Quality and DeLuxe systems, some of which include two 400-A amplifiers in dual-channel arrangements. Ready access to all connections, tubes and fuses is provided.

Modern-Type Speakers Used

Speakers used in the larger systems are Jensen 18″ models, rated up to 9,000 cycles, separate tweeter speakers not being required with any present-day sound track. Medium-priced systems, and some of the Economy systems, utilize Jensen A-12 speakers, rated from 30 to 7,500 cycles. The smallest Economy systems use 12″ dynamic speakers not intended for modern wide-range reproduction. Speaker arrangements can readily be modified to meet any acoustic conditions, both of the Lafayette amplifiers used in these systems offering a choice of nine different output impedances, ranging from .35 ohms to 500 ohms. Baffles of several types—flat, semi-directional and strongly directional — matching the acoustic requirements of any auditorium, are available with all systems.

Projector and sound-head drive is provided in all installations by G. E. constant-speed motors for 60-cycle, 110-volt a.c. The two models are designated as standard duty and heavy duty types, and are of 1/6 and ¼ horsepower, respectively.

* I. P. for June, 1936, p. 14; and for October, 1936, p. 14.



Soundhead for low-cost Facsimili-tone reproducing system

Requests for the new Wholesale Radio Co. theatre catalog (No. 68T-77D7) and the general catalog (No. 68-77D7) are now being honored. Address the company direct at 100 Sixth Ave., N. Y., mentioning I. P.

NEUMADE SPECIAL OFFER TO I. P. READERS EXCLUSIVELY

Neumade Products Corp.'s special offer for one week only (April 5 to 10) makes available to I. P. readers exclusively a $2 Neumade Cement Applicator Set for only 50c. To get this set at this low price projectionists must present to a recognized supply dealer the coupon which is published elsewhere in this issue. No coupons will be accepted after expiration of the date specified.

The Neumade Applicator, finished in black enamel or chrome as desired, flows the cement on the film evenly over the whole splice. It can't tip over. Hundreds of these sets are now in use.

AEROVOX CANADIAN PLANT

Control of the former Polymet Delta Co. of Hamilton, Canada, has been taken over by Aerovox Corp. Henceforth the Canadian plant will operate as Aerovox Canada, Ltd., producing a line of Aerovox dry and wet electrolytic condensers, also mica and paper condensers, for the Canadian trade, which may now obtain genuine Aerovox condensers produced in their own country. The products will be made under the Aerovox patents in Canada, especially those covering the electrolytic art, which are identical to those in the States.

ACETATE FILM SAFEGUARDS

Like all cellulose products, cellulose acetate during combustion or decomposition gives off irritating and suffocating fumes. Results of research tests conducted at Underwriters' Laboratories indicate that 1 pound of cellulose acetate yields about 1 cu. ft. of gas when heated in a closed vessel without excess of air. These gases include principally carbon dioxide, carbon monoxide, hydrogen, methane, alcohols, acetic acid, ketones, and aldehydes.

Perhaps the most important safety factor with reference to cellulose acetate film is its slow combustion, which can be stopped easily by applying water or by smothering the fire. It is therefore possible to provide measures readily for controlling film fires involving cellulose acetate.

THE RIGHT AND WRONG USE OF SOUND EQUIPMENT TESTING UNITS

By *LEROY CHADBOURNE*

NON-EXISTENT troubles can be "found" by improper use of test equipment, occasioning wild-goose chases while the real difficulty remains unsuspected and uninvestigated. The wrong test instruments, or the right ones used the wrong way, can easily damage equipment, adding new troubles to those already present. The circuits of an amplifier, for example, must be understood before it is possible to intelligently apply a voltmeter thereto, and the operation of the voltmeter itself must be understood. When a meter of any kind is applied to electrical apparatus, both constitute a single electrical unit, the behavior of which is dependent upon the construction of each of the two component parts.

For example, suppose an ammeter is wired in series with an electric lamp bulb, to read the amount of current flowing. The reading is never entirely accurate. The meter itself adds resistance, however low, to the circuit, and the reading is always a trifle less than it would be with the meter absent. In this case the error is unimportant, because the normal current drawn by the lamp will be very large compared with the small change resulting from insertion of the meter in the circuit.

In sound amplifiers, on the other hand, the projectionist has to deal with currents that may be as small as a few microamperes—millionths of an ampere—and with circuits embodying resistors rated in hundreds of thousands or millions of ohms. Under such circumstances application of meter leads can alter the performance of the amplifier. The nature of the amplifier circuit is such that the meter action may become apparently inaccurate, giving unrepresentative readings and indicating troubles which do not exist. What is true of meters is true of other testing equipment.

Among meters, a chief offender is the voltmeter of the ordinary moving-coil type commonly found in projection rooms. Much worse, however, is the cruder moving-vane type, sometimes used because it is very cheap. It is valueless and dangerous in dealing with sound equipment; it should never be used. This meter, which can be bought retail at from fifty cents to two dollars, contains a coil of wire wound around a hollow core. The coil is roughly twice as large as the one found in a telephone receiver. The wire is heavy, sometimes as heavy as No. 20. The coil has a very low resistance.

A bit of soft iron, joining the indicating needle at an angle, is so mounted that it can be drawn into the hollow of the coil when the wire is energized. In moving into the hollow of the coil the iron armature, or moving vane, swings the indicating needle, of which it is a part, and a reading results. Back tension is provided by a spring which limits the penetration of the armature in accordance with the strength of current flowing, and hence limits the meter indication.

Meter Extremely Inefficient

This instrument is, of course, an ammeter, the indication being proportionate to current flow. However, the resistance of the coil is fixed and cannot change, and any current reading can, by Ohm's Law, represent only one possible voltage. Therefore the dial can be and usually is calibrated to read volts.

The trouble with this instrument is its inefficiency, the result of its very cheap construction. Because it is inefficient, a rather heavy current is needed to show an appreciable reading. The resistance of the coil must be made very low, to permit a sufficient flow of current under ordinary voltages. Applied to a sound amplifier, a voltmeter of this kind is likely to constitute a short-circuit. Its use may result in some part of the amplifier burning out. If it does no harm, however, it still is unlikely to do much good. In many sound circuits, its readings will not be even roughly accurate.

Its extreme inaccuracy in sound work is easily understood. Suppose a meter of this kind to need, say, fifty milliamperes in order to give a reading of 100 volts. It will be used to check the plate voltage at a vacuum tube socket. Now, the plate current, let us suppose, reaches the tube through load and decoupling resistors that aggregate 20,000 ohms. The normal plate current is 5 mils, or 1/200th ampere; 100 volts are dropped in the series resistors and 100 volts are applied at the plate of the tube. The rectifier's d.c. output is therefore 200 volts. A meter requiring 50 mils, 1/20th ampere, is applied at the tube socket. To get 1/20th ampere through the 20,000-ohm series resistors would require a d.c. rectifier output at 1,000 volts. The power transformer isn't made for it. Therefore the meter can't get enough current to read 100 volts, although 100 volts are there. It may indicate something less than 20 volts, under these circumstances, and lead the projectionist to believe that the trouble is in the power circuits.

It is plain also that since the meter will permit a flow of close to 10 mils, whereas the tube, not shorted by the meter, permits a flow of only 5 mils, there is a distinct chance that the plate series resistor may be burnt out. The use of such meters in association with the power tubes of an amplifier may also damage the power transformer.

Most Common Projection Meter

These comments refer only to the cheap, crudely made type of moving-vane voltmeter. The well-made article is in every way as reliable as the moving coil type, but is not often found in the projection room.

The voltmeter used in most projection rooms for sound testing is actually a 0-1 milliammeter. Many of these instruments are wired, as explained hereafter, to serve as voltmeters, reading

Erratum

The eagle eye of George J. Fahey, of Norwich, Conn., spotted an error in I. P. that will especially interest those who save for future reference the various amplifier tracings that appear herein. In discussing the new W. E. 91A in our November, 1936, issue, the second paragraph in the third column on page 20 should have read:

"Regarding the plate and cathode of V-1 as the poles of a generator of amplified speech a.c., trace from the plate up and *right*, down through the lead R-4; down, left and down through the left-hand C-4 condenser; left as far as possible; up, *right*, up and *right* through C-1 to cathode."

The three italicized words in the preceding paragraph indicate the error, the word "left" having been used in error in all three places.

both voltage and current. In certain amplifier circuits, however, the use of even these meters may be thoroughly unreliable, although less likely to do damage. These meters, used as voltmeters, are rated at "1,000 ohms per volt"—a rating that really indicates their current requirements.

The moving element can be seen, in most of these meters, just under the indicating dial. It is a double coil of wire, pivoted on jewels which permit it to rotate freely. The indicating needle rides with the coil. The coil is mounted in a path of magnetic flux, provided by a horseshoe magnet. Current is carried to the coil through two metal spirals which also act as springs, opposing the rotation and limiting it in accordance with the strength of the current. Rotation takes place, of course, by virtue of the interaction between the permanent magnet field and the field created when current flows through the coil. Hence, this meter reads current.

The resistance of the coil itself may be as low as 200 ohms, but the sensitivity and efficiency of the instrument permit the use of series resistors to limit current flow. Since the needle gives a full-scale indication to a current of 1 mil, 800 ohms in series with a 200-ohm coil will permit it to serve as a 0-1 voltmeter—total resistance, 1,000 ohms. If 99,800 ohms are connected in series with the coil, the meter will give full scale (1 ma.) reading at 100 volts, and can be calibrated as a 0-100 voltmeter. Its total resistance still is 1,000 ohms *per volt*, and it still requires only one mil for full-scale deflection.

Let this meter be used on the same amplifier plate circuit previously considered. The meter will read only 90 volts instead of a 100. A short and simple calculation shows why.

The source voltage is 200 d.c. Five mils flow through 20,000 ohms of plate resistor—voltage drop, 100 volts. The tube socket voltage must therefore be 100, and that is what a vacuum tube-type voltmeter would show. Five mils continue around the circuit through the tube, which may therefore be considered to have a d.c. resistance of 20,000 ohms.

Applying to that socket a 0-100 voltmeter, rated at 1,000 ohms per volt, places 100,000 ohms in parallel to the tube's 20,000. The familiar formula is:

$$\frac{1}{\dfrac{1}{20{,}000}+\dfrac{1}{100{,}000}}$$

which works out by simple arithmetic to 16,666 ohms net effective resistance when 20,000 ohms are paralleled by 100,000. The total load upon the 200-volt source has now been reduced from 40,000 ohms to 36,666. The current flow is now 200/36,666 or 5.4 mils. This current divides, between the tube and the meter, inversely as the ratio 5:1—in other words, out of every 6 parts of current the tube gets 5 and the meter 1, or 1/6th of the total. But 1/6 of 5.4 mils is .9 mils. And at .9 mils this meter reads only 90 volts.

The error becomes much more serious when a meter of this kind is used to read grid bias voltages. Let the meter be the same, set to read the 0-10 volt scale, and therefore with an effective resistance of 10,000 ohms. It will be used to check a 4-volt grid bias. The bias will be applied to the grid through a resistance of high value, 100,000 or even 1,000,000 ohms. The source voltage is 4.

Then 4 volts operate through 110,000 ohms to produce a current of 4/110 mils, or about 1/27th of a mil. All of this current flows through the meter, in the present case, since the grid is an open switch. Since the meter needs 1 mil to show 10 volts, the actual reading is 1/27th of 10, or something less than ½ volt.

If, on the other hand, the meter is used on the 0-100 scale, the apparent reading becomes slightly more accurate. In that case 4 volts operate through 200,000 ohms to produce a current flow of 1/50th of a mil. This, on the 0-100 scale, shows as 2 volts.

Recent Units More Efficient

Meters lately introduced to the theatre field are more sensitive than the conventional 1,000-ohm-per-volt type and consequently give closer readings. They are micro-ammeters, some requiring only 50 microamps, or 1/20th milliamp, for full scale deflection. With a meter of this kind, the grid bias problem just examined gives different results. The 10-volt scale is read through 200,000 ohms, giving a total of 300,000 in the grid circuit in question. We then have a current of 4/300,000 multiplied by 1,000,000 (to show microamperes) or about 13 mma. This is 13/50th of the current needed to show 10 volts on the meter, and the actual reading will be 2.6 volts.

Using the 0-100 scale puts 2,100,000 ohms across 4 volts, resulting in a current of 40/21 mma., or about 2 microamperes. This is 1/25th of the current needed to show 100 volts, and the meter will read approximately 4 volts, as it should.

Returning to the plate current problem discussed previously, it will be remembered that the source voltage was 200, there were 20,000 ohms in series with the tube, and the current flow was 5 mils. Reading plate voltage at the socket, with a 20,000-ohm-per-volt meter makes the meter resistance 2,000,000 ohms. Using the same formula as before, the total resistance of the circuit, with this meter connected, is shown to be 39,801 ohms. The current flow increases from 5,000 mma to 5024 mma. The current again divides, splitting 20,000:2,000,000, or 1:100. The meter receives one part in 101 parts, or 5024 mma. divided by 101, or something more than 49.7 mma. Since only 50 mma. are needed to show 100 volts, the reading will actually work out to a voltage of about 99.2.

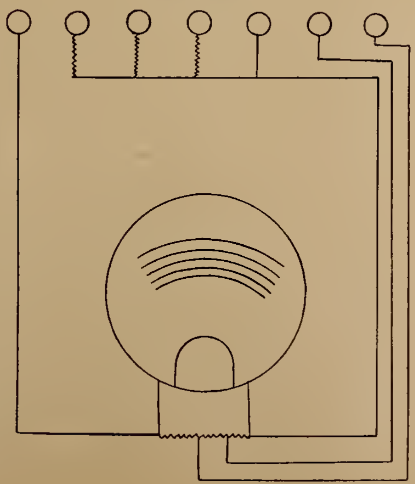
It will be remembered that the 1,000-ohm-per-volt meter showed only 90 on the same circuit, and the cheap and useless little 20-ohm-per-volt moving-vane gadget along about 10. Equally interesting increases in accuracy follow when high resistance (low current) meters are used as ammeters rather than voltmeters, as now explained.

It is clear from what has been said that any of the better voltmeters can be used as multi-voltmeters, reading several scales, merely by mounting suitable resistors in the instrument and equipping it with a number of binding posts. The common binding post, used for all readings, is wired directly to one side of the moving coil, the other side of which is wired to several resistors, each terminating in a binding post of its own, to which connection is made as desired. The dial is calibrated in a suitable number of scales.

Series resistors are desirable in a voltmeter, as has been seen, and the higher their value the more accurate the reading and the smaller the disturbance in the circuit being measured. A voltmeter is connected across a circuit, or part of a circuit. A vacuum-tube voltmeter, which has infinite resistance, is to be preferred above all others.

But an ammeter is connected in series with the circuit to be measured, and series resistors would reduce the cur-

FIGURE 1



rent flow in that circuit. An ammeter is most accurate when its resistance is as low as possible. Ammeters are used with shunts, as needed, to by-pass most of the current around the moving coil. The shunts have lower resistance than the coil, and current divides in the inverse ratio.

Obviously, if the meter needs less current for a given reading, the resistance of the shunt can be decreased, by-passing still more current around the instrument. And the lower the resistance of the shunt, the smaller will be the change of current flow caused by inserting the ammeter in the circuit.

In this case, as in the voltage calculations already given, the coil resistance of a 0-50 mma. instrument has been treated as the same as the coil resistance of a meter reading only 0-1 mil. Actually, the latter will usually have a lower coil resistance. But the resistance of the coil is so small, in proportion to the values of series resistors or multipliers used with a voltmeter, that it is of no importance at all. Similarly, in the case of an ammeter, the resistance of any coil is so high, compared with the value of the shunt, that it may again be neglected, except for extremely small currents, and a very high degree of accuracy in calculation.

Just as the same instrument can be built to serve as a voltmeter showing a number of scales, by incorporating with it a corresponding number of series resistors, so it can be made to function as a multiple-scale ammeter, milliammeter, *etc.*, through a series of binding posts connected to suitable shunts.

Combination Volt-Ammeters

Further, combination volt-ammeters, having several scales for both voltage and current readings, are entirely practicable and of course economical. One common circuit is shown in Fig. 1. It will be noted that the shunt is always connected across the moving coil, even when used as a voltmeter. It serves a supplementary function in "damping" the indicator needle—reducing its inherent tendency to oscillate about the point of final reading—by providing a path of suitable resistance for the counter e.m.f. generated in the coil when it moves through a magnetic field. It is called "a series shunt."

The extreme left binding post of Fig. 1 is the common, and always used. Reading from left to right, the next three, connecting to series resistors, are for voltage readings. The next three are for current readings. Of these, the first is for lower, the second for medium, and the extreme right-hand post for higher current values.

From the foregoing, it should be plain that the proper use of d.c. voltmeters and ammeters on sound equipment implies a reasonable knowledge of the ratings and characteristics of the test instrument and constant recognition of the fact that the meter needle is likely to be a liar. Its readings are never a final indication of trouble until they have been reinterpreted by application of Ohm's Law.

Conversion to an Ohm-Meter

Ohm-meters used in the projection room are of many kinds, often rough and ready home-made contrivances. A trouble lamp is essentially an ohm-meter, in which a more or less known voltage, that of the line, is applied to the circuit under investigation; while the lamp itself acts as a crude ammeter, showing that there is enough current flow to heat the filament. The same holds true of a battery and buzzer. Substitute for the buzzer the inexpensive meter mentioned previously, and it is only necessary to re-calibrate the meter in ohms to have a true resistance meter.

The instrument shown in Fig. 1 can readily be converted into a very satisfactory ohm-meter. All that is necessary is to add a dry cell in series with the common lead, and to use the proper binding posts, calibrating the corresponding scales to show resistance. Since the battery voltage can be taken as constant, every meter reading corresponds to a definite external resistance, the value of which can be printed on the dial. The combination analyzers that are sold for testing sound apparatus consist, so far as d.c. readings are concerned, only of Fig. 1 with the additional provisions just mentioned for reading resistance.

Calibrated for RMS Value

No ohm-meter or ohm-meter arrangement should ever be used on sound equipment unless the resistance included is enough to keep the current down to 1 mil or less. Test lamps, buzzers and low-resistance meters are therefore taboo, and the same restriction applies to low-resistance headphones. Transformers and occasionally choke coils, as used in sound equipment, can be saturated by remarkably small current values. It is only necessary to remember that tubes in a sound amplifier may have plate currents of not much more than 1 mil. The secondaries of sound transformers, if wired to grid and cathode, will carry no d.c. at all. The cores of those instruments are designed accordingly. Extremely small values of direct current may magnetize such cores enough to effect a permanent change in the frequency response of the transformer, and therefore of the sound system as a whole.

Coils wound to carry currents in the order of 1 mil can also burn out very readily if tested with high-current instruments.

The meter of Fig. 1 can be used to read a.c. circuits by means of a suitable rectifier, for which purpose small copper-oxide discs are commonly employed. They are connected in standard full-wave circuit. Rectifier filters are not needed. The a.c. scale of the meter is usually calibrated to show the *root-mean-square* or effective value of the a.c., as distinguished from the peak values at each alternation. The rms value of a.c. is identical with the d.c. that produces the same heating effect in a resistor. In using an a.c. meter to determine the ratings required in replacement parts, a margin of at least 1/3 is allowed to take care of the difference between the rms reading as shown by the meter and the peak values of voltage and current which the new part will have to withstand momentarily.

Where the meter of Fig. 1 is equipped with a copper-oxide rectifier it can be and often is used as a decibel meter. As such it is usually calibrated for a circuit of 500 ohms. Given the voltage-drop across a resistor of known value the wattage in that resistor can be determined. The decibel reading, against any standard of reference, is always the same for the same wattage. Thus, against the common level of 6 milliwatts = 0, 3 watts are 27 db, 6 watts 30 db, and so on. The meter scale can be marked in db as readily as in watts.

The meter is not a wattmeter, however, and will not read power directly but only against an external resistor of known value. If it is connected across a line of other than 500 ohms, the db readings will be wrong. Correction charts are often supplied by the manufacturer, by reference to which db indications shown on the instument can be converted to the true reading for the transmission line in question. They will be needed for accuracy in reading many theatre circuits.

The Vacuum-Tube Voltmeter

With theoretically infinite input resistance, the vacuum-tube voltmeter constitutes the most accurate instrument, practical for projection room use, that can be used to measure sound voltages. The margin of error in its readings, as determined by imperfections in the input circuit insulation, is nil for all practical purposes. With high but finite input resistance, the vacuum-tube voltmeter still has the smallest margin of error of all practical test instruments, although its accuracy of reading is closely approached by that of the 20,000-ohm-per-volt instrument described previously.

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

ORGANIZATION of film exchange workers featured the month's news. Boston, Detroit and New Haven were first off the mark in obtaining direct A. F. of L. charters; and these, plus St. Louis, which has long been organized, constitute the base for extension of the campaign. The trade press credited the Boston coup to Thad Barrows and James Burke of I. A. Local 182, thus lending color to reports that the I. A. was "vitally interested" in furthering exchange unionization. (Barrows, incidentally, said that "all the credit" for the job was due Burke. However this may be, it is known that these worthies were not in Europe when it all happened.)

These first exchange organizing moves made distributors panicky. The distributor-controlled trade press, while denying that the drive had had or would have any great success, admitted that distributors were busy "correcting conditions" in an effort to halt unionization. An insight into these conditions is had in an article relative to exchanges appearing elsewhere in this issue. It is an established fact that exchange workers, and particularly the girl inspectors, were worked at top speed for long hours for at least six full days each week, for little pay.

Despite the fact that the I. A. has never been granted jurisdiction over exchange workers, the industry generally credits the present organizing campaign as an "insidious" move by I. A. to use unionized exchange workers as a club to force the small, and at present non-union, exhibitors to use I. A. men or risk having their film service cut off. No official statement of position has been forthcoming from I. A., which, however, has made no move to discourage "organizing assistance" by its members. Of interest is the fact that in Boston the exchange delivery workers are affiliated with the Teamsters. An immediate result of the organizing drive was the sudden solicitude of exchange managers for their workers. Promises of better working conditions, pay increases and promotions have been made to exchange people throughout the country in a frantic effort to stave off unionization. There is no doubt that the major distributors are acting in concert in this respect.

Despite predictions in *M. P. Daily* that the exchange drive has "stalled and appears to be petering out for lack of interest on the part of the workers," I. P. is able to say that at least six more exchange centers will be organized within the next month, identification of which at this time might prejudice organization. This much having been accomplished, it will then be comparatively easy to bargain with distributors on a national scale.

Roger Kennedy, c. v. p. of I. A., addressed the Detroit Film Inspectors, Shippers and Poster Handlers Union when the latter was formally presented with its A. F. of L. charter. He said that his appearance was "strictly personal."

In Newark, N. J., conferences continued between the newly formed Theatre Workers Union and theatre managers in an effort to settle a strike of ushers, doormen, porters and cleaners. Demands include ushers, 40-hour week at $18; doormen, 40 hours at $20; porters, 48 hours at $20; cleaners 40 hours at $22; part-time ushers, 35 hours at $16; time and one-half for overtime and a closed shop.

General Theatres Equipment ½-Year Net $959,509

General Theatres Equipment Corp. and subsidiaries report a net profit of $959,509 after all charges for the period from June 1, when the company's reorganization plan went into effect, to Dec. 31, 1936. The profit is equivalent to $1.80 a share on 532,461 shares of capital stock issued or irrevocably authorized to be issued by Dec. 31 next.

Subsidiaries included in the report are International Projector Corp., National Theatre Supply Co., Theatre Equipment Contracts Corp., J. E. McAuley Mfg. Co., Hall & Connolly, Inc., and the Strong Electric Corp. Excluded subsidiaries are Cinema Building Corp. and J. M. Wall Machine Co., Inc.

Net sales for the period from June 1, 1936, to Dec. 31, 1936, were $5,998,159; costs and expenses $5,328,848; operating profit $669,311; other income $662,457; total income $1,331,768; discount on sales, bad debts and provision for uncollectible accounts, development and experimental expense, etc., $145,766; interest $53,710; federal income taxes $114,233; provision for federal surtax on undistributed profits $58,550; net profit $595,509; dividends $1,051,461; deficit $91,952.

Consolidated balance sheet as of Dec. 31, 1936, shows current assets, including $529,319 installment notes maturing later than one year, amounted to $5,493,779 and current liabilities were reported as $899,644. Cash at close of year totaled $1,689,076 and inventories, at lower of cost or market, were $1,285,915.

M.P.T.O.A. Favors Workers Of Course—But . . .

Excerpts from the annual convention report of Edward Kuykendall, president of the Motion Picture Theatre Owners of America:

"Serious labor trouble looms ahead. We of the motion picture industry are in complete sympathy with the man and woman who works for a living, whether they wear a white collar or overalls. Unless those men and women earn more than barely enough to live, there can be no prosperity so far as our theatres are concerned; if we depended on the so-called wealthy class, our theatres would be mostly closed. Therefore, there can be no question as to where our sympathy is, but there must be reason and common sense in labor demands, and in some instances this has not been so.

"I am hopeful that those charged with the responsibility of the policies and demands of labor will proceed with caution and not become unreasonable. Recent attempts to organize film exchange employees and others of a like service is very unfortunate. It is unworkable and without cause. Anyone with any knowledge of the details of operating an exchange knows this. But we might as well look ahead and prepare for a battle to defend our interests and rights; it is coming and we cannot stand idly by and see our investments lost."

Test N. Y. Injunction Law

An injunction against picketing of his Lyric in Rochester, N. Y., secured by the owner after he had discharged a projectionist is the basis of a test of the constitutionality of the so-called labor anti-injunction law, passed by the 1935 N. Y. State Legislature.

The theatre owner charges that the defendants, I. A. Local 253, entered into a conspiracy to force him to sign a union contract. Instead, he discharged the projectionist and operated the projector himself. Thereupon, he charges, pickets appeared before his theatre. He sued for and was granted an injunction to restrain the picketing. Union labor secured the enactment of the anti-injunction law, which prohibits courts from enjoining picketing without first having the complaints tried. This is the first test of the law.

The owner claimed there was no labor trouble at his theatre because he employed no non-union labor. He operated the machine, his wife sold tickets.

Eastman K-D Option Lapses

Eastman Kodak has failed to exercise its option to retain exclusive rights for the manufacture of raw stock to be used in the Keller-Dorian color process, as a result of which the company or its licensees may obtain raw stock from any manufacturer. Grand National is the first company to be licensed by Keller-Dorian for the use of its process for feature production.

REGULATION OF LABOR UNIONS BY STATE OR NATION IS DEFINITELY FORECAST

By *JAMES J. FINN*

MANY and diverse are the views of self-styled labor experts relative to the present disturbed labor conditions in the United States. An explanation and an answer for current happenings and the net result of the titanic battle now raging between labor and capital may be had in almost any gathering of several people. Labor trouble has supplanted bridge and clothes as a prime social topic.

Members of the I. A. apparently have only an academic interest in current labor troubles. Except for the studios, the I. A. membership is spread thinly by reason of having only a few men in each theatre, sometimes only one. To I. A. men majority representation is just a phrase for all practical purposes. Thus, why should they concern themselves with current developments relative to the split in labor ranks or the relation of labor to capital?

So they figure. But they are wrong. The outcome of current labor disturbances will affect the I. A. as a labor organization, however thinly its membership is spread throughout the industry, just as surely as it will affect labor in mass-production industries. Whatever advantages may accrue to labor from the present situation, one very apparent disadvantage, as this observer sees it, will be that from which labor has shied since the organization of the Federation—regulation.

Labor probably could worry along with regulation providing for the establishment of state or national mediation boards (mediation being a nice word for compulsory arbitration, the imposition of which will automatically abolish the right to strike). This is a lead-pipe cinch to happen. But the regulation of labor unions on a national scale that now looms on the horizon will encompass considerably more. What? Just this:

Incorporation, Accounting, Secret Ballot Looms

1. Incorporation of all labor unions, despite the frenzied outcrys that this will make unions creatures of the state.
2. Compulsory periodical audits of all local and national labor union books, a report of which will be sent either to the state or the national government.
3. Institution of and strict adherence to secret ballotting in local and national labor meetings, in order to strip ambitious leaders of the power to arbitrarily order strikes. Employers have a deep-dyed suspicion that union memberships are not infrequently coerced into approving strike calls.

Boards of trade and manufacturers' associations have been yelling loudly for regulation of labor unions for, lo, these many years. But they got nowhere because politicians usually respected the labor vote and chose to offend sixty manufacturers rather than sixty thousand workers. But a quite different situation is taking shape now, based on the politicians' natural instinct for self-preservation.

There are two groups in America that must not be disturbed—politicians and churchmen. Just so long as Mr. John L. Lewis, for example, goes about ministering to the economic needs of some begrimed coal-miner living in a hovel in a jerk Pennsylvania town; just so long as labor riots occasion the death of only a few strikers or National Guardsmen, or both; just as long as the poor saps who fight a months-long battle for a minimum wage of $5 a day and a 40-hour week still cast their ballots for either one of the established political parties—just so long as this happens both the politicians and the churchmen can flit about unconcernedly and express their "concern" and "sympathy" for the "rights" of the workingman.

These "rights," however, do not include the right of becoming politicians. The spectacle of a John L. Lewis with a fol-

lowing of some two million adults of voting age, who thus far have exhibited every inclination to blindly follow their leader, is a different matter altogether. Why, if these fellows should be able to corral a few hundred thousand "nuts" of voting age, they might go places in the political arena. Confronted by this prospect, Mr. Politician is going to act —and promptly.

Labor As a New Political Group

The last national election uncovered the great potential political strength of the American Labor Party, particularly in populous areas like N. Y. State. And just the other evening, Mr. John L. Lewis, speaking in N. Y. City's vast Madison Square Garden before 20,000 listeners, stated flatly his intention of using the C. I. O. as a political instrument. This indiscreet statement fanned to greater heights the flame of fear and resentment in the breasts of politicians, who now see clearly the need for immediate action to protect their allegedly God-given right to mooch off the working people of America for the rest of their natural lives.

"So that's your game." murmer the politicians, who are even now planning to do something to break up the game. Their answer to the problem can be expressed in one word—regulation. It matters little whether Messrs. Lewis, Smith or Jones are merely manipulating a few votes for their own personal advantage. What does matter mightily, however, is that, for all practical purposes, a *new political group* is in the making and is threatening their jobs and all the privileges that go with these jobs.

Even so good a friend of labor and excellent politician as Gov. Murphy of Michigan, harassed and politically embarrassed by the second major automobile strike within two months, let slip into a statement given to national press associations the suggestion that the only cure for the present disturbed labor conditions was—regulation. He didn't specify the type of regulation he thought was needed, but he didn't have to. Any regulation of labor unions devised by politicians will be regulation in every sense of the term—particularly for and in the interests of politicians.

Another contributory factor in the present trend toward labor union regulation is the current racketeering investigation and prosecution in N. Y. City. Directed by young and aggressive special prosecutor Thomas Dewey, palpably a career man in politics, these trials are given extensive space in the large metropolitan newspapers which have wide circulation throughout the country among legislators, and particularly in Washington. Dewey's disclosures of racketeer-labor union ties has evoked the wrath of the N. Y. City Central Labor body, but they have also served to strengthen the demands of those groups who have long asked for labor union regulation by the State.

It is freely predicted, even in labor circles, that repercussions of Dewey's activities will ultimately be heard in the N. Y. State Legislature, if not in the national Congress. Such organizations as the National Manufacturers Association, long a vigorous proponent of union regulation, are merely sitting back and sawing wood, confident that the break which they anticipated is now at hand.

Conservative labor circles, while admitting that some degree of regulation is necessary, are outspokenly fearful of two of the three points mentioned previ-

ously herein as the basis for labor union legislation—incorporation and the necessity for periodic reports of finances. (These two points really should be merged into one, because the first presupposes the necessity for the second.) The incorporation of labor unions, say the leaders, would make the union a creature of the state and would so seriously curtail its "normal" activities as to render it impotent. Labor leaders are forced to adopt the traditional indifferent attitude of labor toward periodic financial reports to the state, the presumption being that since they have nothing to hide they need not be fearful of an accounting. There is no doubt, however, that they have a violent dislike for any such regulation.

Titanic Struggle Forecast

As for the third point relative to a secret ballot on all questions of policy and in elections, labor leaders care not a snap about this, because it is assumed that in most cases the position of a labor leader is a direct reflection of his popularity and would be most effective in bringing his followers around to his own point of view on any particular question.

This article is not an attempt to evaluate the worth of these proposals for regulation; it is intended as a simple statement of the facts as the writer sees them. Labor does not lack any number of clever-visioned, logical-minded leaders who know what they want and do not want, plus an instinct for self-preservation almost as keen as that of the politician. The battle when, as and if the issue is joined will be a titanic struggle for high stakes.

It is much too early as yet to predict the outcome of this struggle for dominant political power; but it is not too early to predict that the victories now being won by labor in its struggle for a greater percentage of the national income are being won at the cost of a definite commitment to engage in the death-struggle in the not too distant future on the issue of labor union regulation by either the state or the national government. This is the lesson and the warning of history.

S.M.P.E. Projection Committee Varied Personnel for 1937

Complete roster of Projection Practice Committee of S. M. P. E. for 1937 discloses unusually well-balanced group. Included are Harry Rubin (Par.), chairman, and members J. O. Baker and A. Goodman (RCA); F. E. Cahill (Warner); J. R. (Books) Cameron, J. E. Elderkin (Forest Mfg.); A. A. Cook (B. & L.); E. R. Geib (Nat. Carbon); A. N. Goldsmith (consulting engineer); H. Griffin and P. A. McGuire (Int. Proj. Corp.); S. Harris (SMPE); J. J. Hopkins (Par.); and C. F. Horstman (RKO).

Also Thad Barrows (Pres., L.U. 182); J. J. Finn (I.P.); D. E. Hyndman and C. Tuttle (Eastman); E. R. Morin (Conn. State Police, to watch the boys); M. D. O'Brien (Loew); G. F. Rackett

(Technicolor); V. Welman (sec., L.U. 160); J. S. Ward (Erpi); F. H. Richardson (B. T.); B. Schlanger (architect); R. Miehling (Loew); and A. T. Williams (Weston).

400 MORE WARNER THEATRES GO RCA HIGH FIDELITY

Existing sound equipment in the entire Warner circuit of more than 400 theatres will be replaced with complete RCA High Fidelity reproducing systems. Some 80 Warner theatres have already been switched over, and the balance will be switched before the end of 1937. The new equipments are able to handle push-pull stuff.

THE PRESENT POSITION OF COLOR CINEMATOGRAPHY

(*Continued from page* 15)

mood induced by a particular color was common to the majority of observers, the information does not carry the producer who has to handle moving color very far. Nor do the list of dyads and triads which are offered as short cuts to color composition.

On the other hand, it is generally admitted that color will involve alterations —perhaps radical—in our methods of constructing a film. The modern film, in which rapidly-changing scenes are shot from constantly-changing angles, yet retains a visual continuity because of its monochromatism—a harmony which disappears with the introduction of a new aesthetic dimension in the form of color. First attempts at restoring this harmony will probably slow up the tempo, just as in early sound films.

Psychological Effects of Color

We know very little as yet of the psychological effects produced by constantly-changing color presented in a darkened theatre, beyond the fact that the combination of vivid color and quick movement gives many people a headache, and that color photographed at its full value will at first call attention to itself and distract attention from the action of the characters. We also know that color, while enhancing some effects may detract from the dignity and impressiveness of others. We know that the close-up is nearly always more attractive than the long shot—particularly in outdoor scenes, where prodigal Nature has not designed the color of her settings in such a way that they will necessarily take second place to the actions of the puppets whose story the producer is attempting to tell. Nor can he successfully concentrate attention on his players by throwing his background out of focus, as he does in monochrome. The meaningless blobs of color in such out-of-focus shots are both worrying and unnatural. The eye will attempt vainly to restore the missing detail, and anything which calls attention to the technical or mechanical features of a screen production is admittedly a handicap. In fact, whereas in monochrome we have a

highly-developed means of artistic expression, in the color film we are still fumbling among first principles.

The Producers' Dilemma

The producer, then, is on the horns of a dilemma. If, as many of us would prefer, he aimed at producing a film in which the contribution made by the presence of color as such remained almost unnoticed — except in our heightened appreciation of the production as a whole—he is gambling perhaps $125,000 of his backer's money that the process will not let him down, that this heightened appreciation will, in fact, result in a feature film earning at least $125,000 more than it would if it were made in black-and-white. It is a gamble which the hard-headed business backers, whose measure of a film's success is its box-office appeal, are hardly likely to take for some time yet.

How then are we to acquire this badly needed information as to how exactly color cinematography should be handled? Since no work of art can deliberately be constructed by the application of formal rules, and since more knowledge of our reactions to color presented in a time sequence is badly required, a case could be made out to show that the next logical step from the color cartoon should be to the color news reel rather than to full-length story films.

In the news reel, aesthetic considerations have only a rudimentary importance, because the news itself is the important thing, and news in color would have just that much more specific interest for the audience that a monochrome photograph, however poorly reproduced in their newspaper, has over a line drawing however accomplished. During the time that the cartoon develops to a real color symphony, the color news film might be used to provide reliable data on what is called our "physiologico-psychological" reactions to film in which the unifying harmony imposed by monochrome presentation is absent. But the color news reel is a field which additive processes may easily have to themselves, since their production costs approach more closely to black-and-white, while there need be no more difficulty in releasing prints on the day the negative is exposed than is the case with monochrome. Processes of the type of Francita or the lenticular systems can offer negatives and prints at practically black-and-white costs to those who are willing to face the fact that *the projection process will require skilled and constant attention.*

Lenticular film stock is somewhat dearer than that used by the Francita process, but, in return, it appears to be capable of better definition. Dufaycolor stock will probably continue to cost as much as that used for three-color subtractive processes, but scores over other additive systems in that it employs a normal black-and-white camera and makes no more demand on the projectionist's intelligence than does black-and-white. All three types are processed at the speed of black-and-white film, and, being additive, are capable of a more truthful color rendering than subtractive systems.

In granting that the lighting equipment in many theatres is only just adequate to project black-and-white, we should not ignore the fact that new types of illuminant, such as the high-pressure, water-cooled, mercury vapor arc, are capable of producing as much light as any additive system will require from *a lamp little larger than a lip-stick*, and that such lamps might easily become standard equipment for other reasons within the next few years.

Cost of Projector Attachments

As regards the cost of fitting projectors with special attachments, it should be remembered that a feature film is estimated to cost at least $90,000 more if made in subtractive three-color than in black-and-white. On the assumption, therefore, that one of the big corporations owning a chain of theatres were to shoulder the cost of equipping its projectors with such special attachments, they could offset this first cost against the fact that they could thereafter undertake the production of color films at an overall cost considerably nearer to black-and-white than is at present possible with subtractive systems.

Even if we assume that to work processes of the type of Francita or the lenticular systems, the projectionist requires to be, as Dr. Kalmus of Techni-

color so happily puts it, "a cross between an acrobat and a college professor," it must be remembered that the modern projectionist is a very different being from his forefathers, and that the demands made upon his skill may, with research, be reduced to no more than that required to operate properly a modern sound projector. In France (de Lassus) and Germany (Siemens-Perutz, Opticolor) projections of lenticular film, which involves the most tricky of all "modified projector" systems, have occurred on a commercial scale.

Finally, even assuming that projection difficulties remain for some time real obstacles to development of such systems, a group which adopted Dufaycolor might profitably re-equip their chain of theatres with mirror arcs and $f/1.6$ projection lenses in place of the more usual $f/2.3$, whereupon, even with present-day sound screens (whose perforations result in a 30 per cent loss of the incident light) they could compete on level terms, so far as illumination is concerned, with subtractive processes shown in other theatres.[1]

A logical case can, therefore, be made out by those who are sponsoring additive processes, even although the average theatre is, at the moment, capable of doing more justice to subtractive color films and the tendency is, therefore, to regard the latter as a safer proposition on a short view.

One of the several features which the big moving picture corporations have in common with a herd of elephants is their liability, when alarmed, to charge as a herd in one particular direction after a leader who has chosen his course, as like as not, by chance. Witness the spate of gangster films, of newspaper story films, of historical films, which followed upon the first box office successes made to these formulae. For some years now this herd has had its beady eyes fixed uneasily on Technicolor—not because it particularly wanted to smear the world with color; indeed it would prefer to be left severely alone—and often said so.

It had hardly recovered from its surprise at Disney's rise to fame on the basis of cartoons it had seen no reason to suppose would be successful when, aided and abetted by Dr. Kalmus, he "stole the program" even more completely by using three-color Technicolor for his Silly Symphonies. The herd pricked up its ears, but the stampede did not start because previous dashes into color had, on the whole, been disappointing. But it only requires that a film, based on a popular story and made by an artist having some idea of the possibilities and limitations of color as a

[1] This estimate of screen light loss occasioned by perforated sound screens does not have the sanction of well-informed technical opinion which places this loss at approximately 10% maximum. —Ed.

medium, should "go over in a big way" for the stampede to start in earnest.

We shall know better where we are when the "Garden of Allah," reported to have cost $2,225,000 has been released generally. How much of this rather staggering sum is directly attributable to the fact that it is a color film I do not know, although it is reported that 1,500,000 feet of negative was exposed.[2] Nor do I think it matters. If Miss Dietrich should prove to be the Delilah who does to monochrome what the jawbone of Al Jolson did to silent films, we shall hear less about the cost, since those who believe that the industry cannot afford color are, I think, mistaken.

An industry which can afford to pay salaries that sound like national debts to people who spend a considerable portion of their working hours in kicking their heels, which can afford to shoot 80,000 feet of negative film to obtain an 8,000-foot feature picture, could, with a little intelligent reorganization, afford the most expensive color system yet devised. It must be remembered that 70,000 feet of unused negative involves a good deal more than the mere cost of the stock. Exposing it involves overheads in salaries, rents and studio expenses generally, which must be covered before the film can make profits. The spirit of the apocryphal Chinaman, who, finding that a dead pig in the ashes of his house tasted good, continued to set fire to houses containing pigs whenever he wanted roast pork, has been abroad so long in the film industry that his methods have become second nature.

On the other hand, suggestions that, from within its substance, it could well afford the added cost of color, naturally do not arouse enthusiasm, and once a color boom has fairly started, additive systems which can show a near approach to black-and-white running costs may legitimately expect to share the market.

In conclusion, it is common to bemoan the enormous amount of money which has been spent on research on color cinematography, and there is little doubt that much of this money has been thrown away. If all the energy, enthusiasm, money and prematurely grey hair had been concentrated on a study of two additive and two subtractive systems, rather than been dissipated over an endless variety of different methods, color cinematography would now be firmly established.

On the other hand, it is doubtful whether the money which has been lost on this subject in the past would pay for even one of those battleships, which having been built, never saw action of any sort and were eventually sold for scrap iron. And a visitor from Mars, when he had finished wondering at the way we run the world, might quite reasonably maintain that the most hopeless research on the problems of color and color reproduction was a more reasonable way of spending a lifetime or a fortune than many others we have devised.

[2] Distributors of "Garden of Allah" state that color helped this picture "immsasurably". A direct question as to whether they felt that the picture would have done as well in black-and-white elicited an emphatic "Positively not" in reply. Selznick, producer of "Allah," has close ties with Technicolor, thus leaving ample room for difference of opinion on point of color-film box office draw. Incidentally, "Allah," which was a "natural" for color treatment, offered delicate pastel shades and confirmed opinion as to injurious effects of indiscriminate color daubing—in other words, levelled the theory of "color for color's sake".

Simplex PROJECTORS — DISTRIBUTED BY NATIONAL THEATRE SUPPLY COMPANY

TRADE MARK REG'D

New Super Simplex PEDESTAL

TRADE MARK REGISTERED

Designed

**TO ACCOMMODATE HEAVY DUTY EQUIPMENT
MEET PROJECTIONIST REQUIREMENTS
AND SECURE THE
HIGHEST TYPE OF SCREEN PRESENTATION**

OUTSTANDING ADVANTAGES

- Provides excellent balance for heavy duty equipment.
- Pivot point insures proper balance and minimum strain.
- Can be easily tilted between minus 3 and plus 33°.
- Lateral adjustment simplifies installation and insures proper centering of picture on screen at all times.
- Weight gives steadiness heretofore unobtainable.
- Spacious internal compartment for all electrical connections.
- Conduit can be brought into compartment through floor or from side.
- Twist lock receptacles for change-over and motor allow ready disconnection of circuit.
- Two switches for motor circuit.
- Four double pole standard outlet receptacles for soldering iron, work light, threading lamp, and arc lamp feed motor provided.
- Universal type spirit level permits accurate levelling, and levelling bolts secure great rigidity.
- Lamphouse support bracket permits accurate alignment of lamphouse and allows for differences in manufacturing tolerances.
- Lamphouse support bracket of adequate length to support new style lamphouse.
- 100 ampere double pole knife switch furnished for low intensity or suprex arc lamps.
- Heavy switch supporting bracket can be furnished at additional charge for high intensity arc lamp.
- Any standard change-over switch may be attached.
- Spacers provided to accommodate existing port hole construction.
- Soundhead supports to meet requirements of any soundhead attachment.

Simplex
TRADE MARK REGISTERED
The International Projector

INTERNATIONAL PROJECTOR CORPORATION
88-96 GOLD ST. NEW YORK, N.Y.

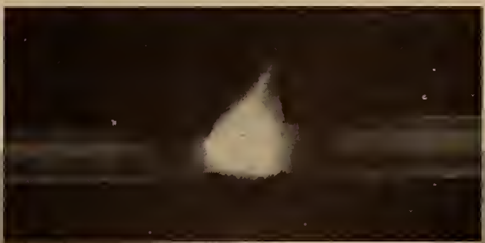
Ip

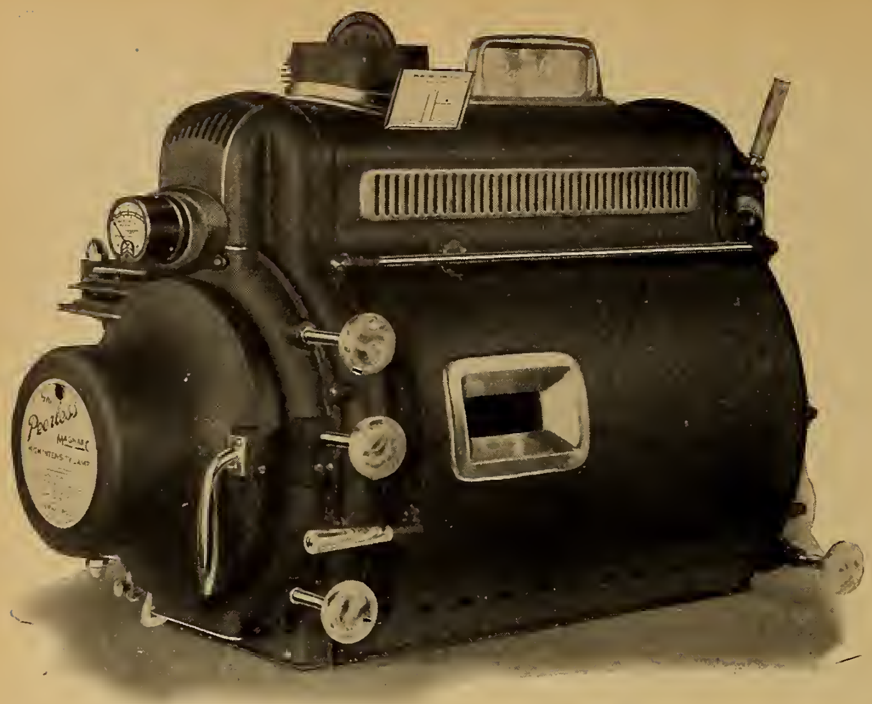
International PROJECTIONIST

APRIL 1937 Vol. 12, No. 4

25c Copy $2 a year


NATIONAL





YOU CAN'T EQUAL

Peerless MAGNARC

TRADE MARK REG.

VALUE AND SUPERIOR PERFORMANCE

SINCE its introduction this projector arc lamp has made an enviable record. It instantly was recognized the leader, and has ever since retained that leadership.

Peerless Magnarc Lamps have been adopted as standard factory equipment by the manufacturers of the world's finest projector, the Simplex.

Today it is the greatest dollar-for-dollar value and the finest projector arc lamp ever built.

THAT IS WHY THERE ARE MORE PEERLESS MAGNARC LAMPS IN USE THAN THE COMBINED TOTAL OF ALL OTHER MAKES

SOLD BY

NATIONAL THEATRE SUPPLY CO.

MANUFACTURED BY

J. E. McAULEY MFG. CO.

552-554 WEST ADAMS ST. CHICAGO, ILLINOIS, U. S. A.

International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 12 APRIL 1937 *Number 4*

Published Monthly by

JAMES J. FINN PUBLISHING CORPORATION

580 FIFTH AVENUE, NEW YORK, N. Y.

Circulation Manager, RUTH ENTRACHT

SUBSCRIPTION REPRESENTATIVES

AUSTRALIA: McGills, 183 Elizabeth St., Melbourne
NEW ZEALAND: Te Aro Book Depot, Ltd., 64 Courtenay Place Wellington
ENGLAND AND DOMINIONS: Wm. Dawson & Sons, Ltd., Pilgrim St., London, E. C. 4.

YEARLY SUBSCRIPTION: United States and possessions, $2 (two years, $3); Canada and foreign countries, $2.50. Single copies, 25 cents. Changes of address should be submitted two weeks in advance of publication date to insure receipt of current issue. Entered as second-class matter February 8, 1932, at the Post Office at New York, N. Y. under the act of March 3, 1879.

420

MONTHLY CHAT

HUNDREDS of film clips and thousands of burning words anent the delinquencies of exchange film inspection technique were deposited on our desk as a result of the exchange article appearing herein last month. Publication of this material would serve no useful purpose, so familiar is the field with mutilated film, one piece of which looks pretty much like the other. Very disturbing, however, is the fact that many sample clips evidence sloppy joining by the exchanges.

This is one rap that cannot possibly be passed along to Mr. Projectionist. Whatever it is in the form of organization that is now hitting the exchanges in the neck apparently was too long in arriving.

SOUND equipment company income is now largely a matter of recording royalties and service fees. The latter is not so hot, either, with many $5 weekly contracts in force. Quite a far cry from an income of 20 millions in a single year from equipment sales.

MANUFACTURERS report a decided slump in the demand for Suprex arcs. This lamp, strangely, has failed in its original purpose of supplanting the low-intensity arc, many thousands of which still remain in use. This circumstance suggests a very poor selling job on Suprex by projectionists and supply dealers. Managers and owners know little if anything about such matters, and their dope must come *via* the projection room.

I. P. has agreed to test again the so-called mirror guards or reflector shields, the use of which was frowned upon sometime ago because of their proven inefficiency. The manufacturers insist that many projectionists find these units perfectly satisfactory. We shall see.

SOME of the boys are again falling for that old correspondence school gag—this time to "learn" television. This corner advises forgetting about such schools, several of which have already been given a quietus by the Federal authorities, and none of which can "teach" much at present other than how to be a prize chump.

TWO new types of screens are being tested, one with gradational perforations, intended to correct uneven light distribution, and another solid type with perforations on the masking. More anon about these, when test results are forthcoming.

FOR the 'steenth time we repeat our request that subscribers notify us of changes of addresses as far in advance as possible. Failure to do so means unwarranted expense to the publisher and inconvenience to the reader. A penny postcard, bearing both old and new addresses, will do the trick.

INTERNATIONAL PROJECTIONIST

VOLUME XII NUMBER 4

APRIL 1937

NEW AMPLIFIER FEATURES REFLECT RAPID PROGRESS IN DESIGN

By *LEROY CHADBOURNE*

PROGRESS in the design of amplifier circuits has been so rapid that a person whose knowledge of amplifiers stopped with the developments of only a year ago might find it impossible to trace a present-day blueprint and understand its meaning. Among the most interesting of recent developments is automatic volume expansion as used for the reproduction of sound records.

The need for this feature lies in the fact that all known methods of recording unavoidably introduce volume compression. The simplest example of volume compression in recording is found in the common phonograph record, where the groove swings from side to side, and the extent of the swing governs the volume. It is obvious that if the groove swings too far it will cut over into the next one. Commercial requirements, which demand maximum playing time from a record of given diameter, dictate that the grooves shall be spaced close together. In consequence, extreme volume is never recorded on such records.

In a motion picture sound track of the constant-density type, the width of the clear area governs the volume. To record even an orchestra at full volume would require a much wider track than at present, and the introduction of such recording would necessitate scrapping every projection machine. To record thunder, traffic noises, *etc.*, would require a track of still more generous proportions. Similarly, in the case of the variable-amplitude type of track, greater maximum volume would also mean greater width, since the blacks cannot be made blacker, or the clear portions clearer, than at present.

Since the volume expansion circuits used in reproduction are intended to compensate for volume compression in the recording, it is necessary to examine the recording process in some slight detail. The weaker sounds are photographed on film, or cut on a record, exactly as they would be if there were no such thing as volume compression. All other sounds, up to the maximum possible, could also be recorded at normal volume, with suitable controls to avoid any further increase after maximum were reached; but if that were done the result would be unnatural. There would be no difference at all between medium-loud sound and very loud sound. To preserve the illusion of such difference, volume compression begins at a comparatively low level of sound, which is reduced a trifle below normal. As sound grows louder, the percentage of reduction in volume increases, and extremely loud sound may be cut to a small fraction of its proper volume, although still recorded more strongly than any other.

Equipment Noise Level Factor

It may occur to the reader that the minimum volume could be made much weaker, and the need for compression avoided in that way. This would be true if reproducing apparatus were absolutely noiseless. Since it is not, the minimum sound volume must be given sufficient power, on the record or film, to lift the reproduction above the level of those equipment noises that are amplified along with the sound.

Manual compensation can be used in ordinary reproduction, and often is. Thus,

a sound picture may be cued for the best dramatic effect, a process that involves raising the volume control in the theatre during certain passages, which should be played more loudly than the sound track gives them.

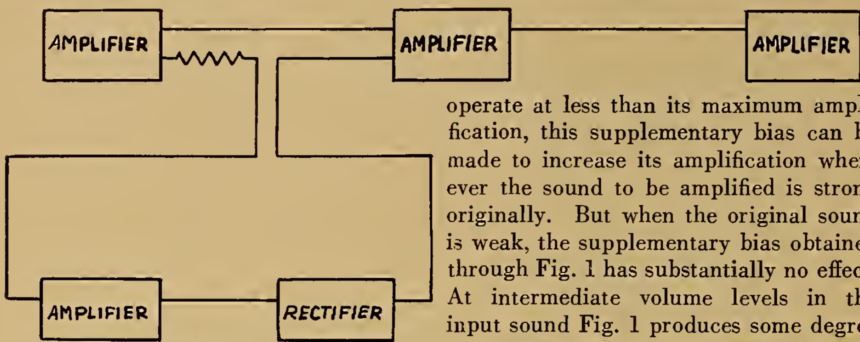


FIGURE 1

Automatic volume expansion does the same thing without human intervention, and does it more accurately. Under ideal circumstances (those in which the volume expander circuit has been matched with the compression used in the recording in question) the result is an exact duplicate of the volume range of the original sound—with one qualification. The original volume is reproduced only so far as amplifier and speakers are capable of handling it. If the speakers are not capable of working at the volume level of a full orchestra, no expander circuit can give them the additional capacity. But if they are capable of handling such sound, the volume expander circuit will deliver it to them regardless of the limitations of the record (assuming, of course, that the output stage of the amplifier is similarly capable).

The basic idea of volume expansion is shown in the block schematic of Fig. 1, in which each of the rectangles, or blocks, that are labelled "amplifier" may be taken to represent either one or more stages of amplification. Each may be a separate amplifier, or all of them, together with the "rectifier" block, may be tubes in a single unit or cabinet.

Sound input is supplied to the block in the upper left-hand corner. From this amplifier or stage two outputs emerge in parallel. The upper line leading from the right of that block represents the normal transmission to the next stage of amplification; from which in turn transmission continues tc the extreme right-hand stage. To this extent the arrangements are entirely conventional. But the lower output from the top left-hand amplifier runs through a resistor, which here signifies merely a reduction in volume, not a circuit arrangement—and thence to the lower left-hand amplifier. The output from this runs to a rectifying circuit in which it is converted to d.c. The d.c. thus obtained is applied to the upper middle amplifier as a second source of grid bias.

Obviously this second grid bias will vary in value according to the volume of the original signal. If the upper middle amplifier is primarily so biased as to operate at less than its maximum amplification, this supplementary bias can be made to increase its amplification whenever the sound to be amplified is strong originally. But when the original sound is weak, the supplementary bias obtained through Fig. 1 has substantially no effect. At intermediate volume levels in the input sound Fig. 1 produces some degree of increase in gain, but less than that which is obtained at maximum input.

Details of Circuit

Circuit details of Fig. 1 will be found in Fig. 2. These diagrams correspond exactly, except that Fig. 2 omits the extreme right-hand block of Fig. 1. The two upper tubes correspond to the upper left and upper middle blocks of Fig. 1; the lower left-hand tube to the lower-left block, and the lower right-hand tube to the rectifier.

Sound input enters Fig. 2 at the upper left, and is wired to grid and cathode of the first amplifying tube. Considering the plate and cathode of that tube as poles of a source of amplified speech a.c., the load can be traced from plate up, right, down through two resistors, and left through a condenser to ground. A parallel path of conventional condenser coupling runs from the plate right to the top grid of the upper right-hand tube. The cathode of that tube will return to ground through a grid bias series resistor or perhaps one of the new "semi-fixed" bias circuits, as explained in association with Fig. 3.

A second parallel path—the lower output of Fig. 1—may be traced from the plate of the top left-hand tube up, right, down through the first resistor, left through a condenser, and down and right to the grid of the lower left-hand tube. The fact that this path branches off between the two resistors, and not at the plate itself, results in the decrease of volume which in Fig. 1 is represented symbolically by the series resistor.

Now follow the plate load of the lower left-hand tube from the plate up and right; up, right through a coupling condenser; down, right, up through the lower half of the center-tapped resistor, and left and down to ground. A parallel path, however, exists through the rectifier tube. From the lower end of the center-tapped resistor trace to the right and up to cathode; by emission to plate, from plate up and left, down through the upper half of the center-tapped resistor, and so again to ground. This parallel circuit, of course, operates only on one-half of the speech a.c. cycle.

From the plate of the rectifier trace up, left, up and right to the control grid of the upper right-hand tube. The rectifier delivers bias to that grid only when its plate is positive with reference to its cathode, which of course is the only time current flows through it. This bias is always positive with reference to ground by the extent of the voltage-drop across the upper half of the center-tapped resistor. When the speech a.c. reverses polarity, no current flows in the rectifier, and none in the upper half of the center-

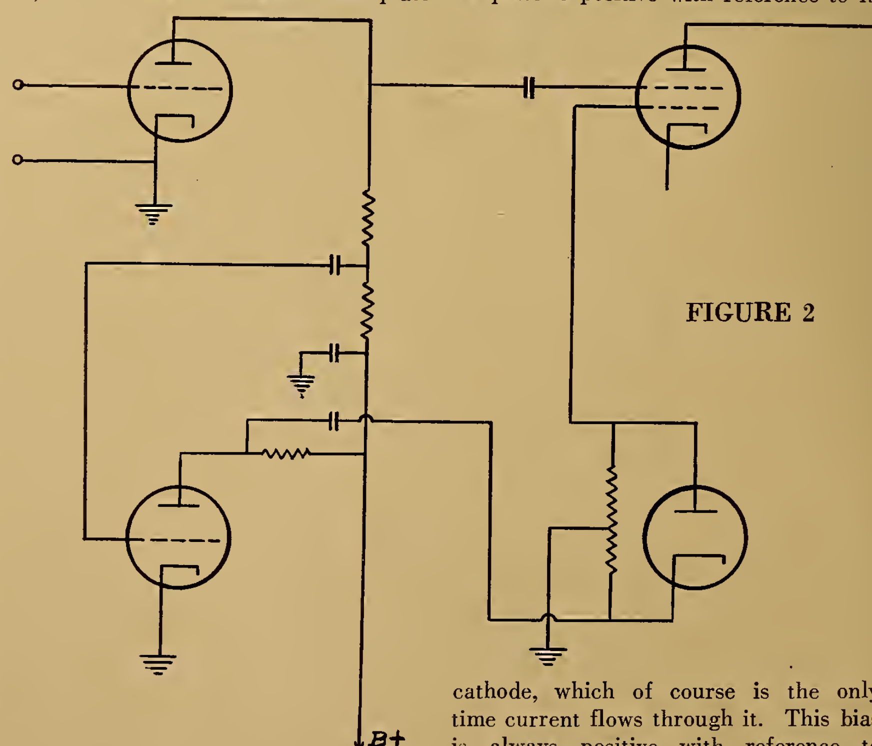


FIGURE 2

tapped resistor; and the control bias of the upper right-hand tube is ground potential.

Positive grid bias in a circuit of this kind increases emission from the cathode, and increases amplification, the extent of which depends of course upon the value of positive bias applied; and this in turn depends directly upon the volume level of the original signal.

Fig. 2 represents a mere skeleton circuit, from which many small details have been omitted. For example, the bias line running from the rectifier to the control grid of the upper right-hand tube should include a series resistance of high rating. This is necessary to limit the grid current—the attraction of electrons by the positively-charged grid—to an unimportant value. In the skeleton circuit as drawn this resistor is not shown.

Fig. 2 is further subject in practice to many variations in detail. Thus, if the parallel path from the upper left-hand tube is taken at the plate of that tube, instead of part way down along the plate resistor (that is, the series resistor of Fig. 1 being omitted) it may under some circumstances be possible to dispense with the lower left-hand amplifying tube. Another and much more interesting modification of Figs. 1 and 2 involves their use for automatic volume control, which is substantially the reverse of the automatic volume expansion just described.

Automatic volume control is not used or desired with recorded sound of any kind, but is distinctly advantageous in connection with a microphone. Expansion, which only compensates for compression in recording, is not wanted with a microphone at all.

A.V.E. (automatic volume expansion) operates to increase and accentuate differences in input volume. A.V.C. (automatic volume control) acts to iron out differences in original volume, and to keep sound level very nearly constant regardless of input changes. The advantages of a.v.c. with a microphone input are to some extent obvious. For instance, the speaker or artist may turn his head toward or away from the instrument as he pleases, addressing himself to the audience in the most natural manner, and sound volume will change very little if at all.

Acoustic Feedback Condition

Another advantage, less easy to understand, relates to the condition of acoustic feedback. When speakers and their microphone are located in the same auditorium, some speaker sound must inevitably get back to the microphone. When the feedback sound is loud enough, the entire system will squeal, and nothing else will be heard. The same condition can be created in an ordinary telephone, as everyone knows by holding the receiver against the transmitter.

Acoustic feedback is avoided, in microphone work, by carefully pointing speakers away from the microphone, using directional baffles or trumpets closed at the rear; also when necessary by help of a directional microphone which responds only to sound that reaches it from the desired angle or angles; but in spite of these and other precautions reduction of speaker volume is often found imperative. Then if the speaker approaches the microphone too closely, or talks or sings too loudly, the necessary limitation of volume may be overcome and howling set in. To avoid this possibility volume is commonly set rather far below the feedback limit, and sometimes to a level where the audience cannot hear as well as it should.

A.V.C., which automatically prevents the user from increasing speaker volume beyond a predetermined limit, makes it possible to serve the audience satisfactorily without any risk of feedback.

Fig. 1 might be the block schematic of an a.v.c. circuit, as well as of a.v.e. Fig. 2 also might represent a.v.c., if only the two wires running to the rectifier tube were reversed. In that case, current would flow through the upper half of the center-tapped resistor only when the upper end of that resistor was negative with respect to ground; and the bias applied to the control grid of the upper right-hand tube would be negative instead of positive. But a negative bias would tend to choke back emission from the cathode and to reduce volume. Just as before, the effect would increase in proportion to increase in the power of the input signal, but now a stronger input signal would mean less amplification, and the weak input would be the one amplified most strongly.

Since the difference between use of Fig. 2 for a.v.c. and a.v.e. is so small, we may assume that the same circuit can be made to perform both functions, merely by wiring the leads to the rectifier tube through a polarity-reversing switch. In practice, however, such a switch may carry supplementary terminals which are used to vary some of the constants of the circuits in accordance with the exact value of the results desired in each service.

Fig. 3 represents a two-stage amplifier in which there are two different sources of grid bias, one conventional and one relatively new.

Fig. 3, like Fig. 2, is a skeleton drawing. The input might be wired to the grid and cathode of the left-hand tube, and the output taken from plate and cathode of the right-hand tube. In both cases these cathodes are wired in series with dropping resistors. If the lower ends of those dropping resistors were returned to their respective grids through any high-value resistances, the dropping resistors in series with the cathodes would provide grid bias, inasmuch as their lower ends go to the negative terminal of the power supply rectifier, and are therefore negative with respect to the cathodes.

The center-tap of the power transformer plate secondary, at the bottom right of the drawing, is, as usual, the power supply negative terminal, since it is always negative with reference to whichever rectifier plate is operating at any given moment. The filament of the rectifier tube is the positive terminal. Note that, below and just left of the

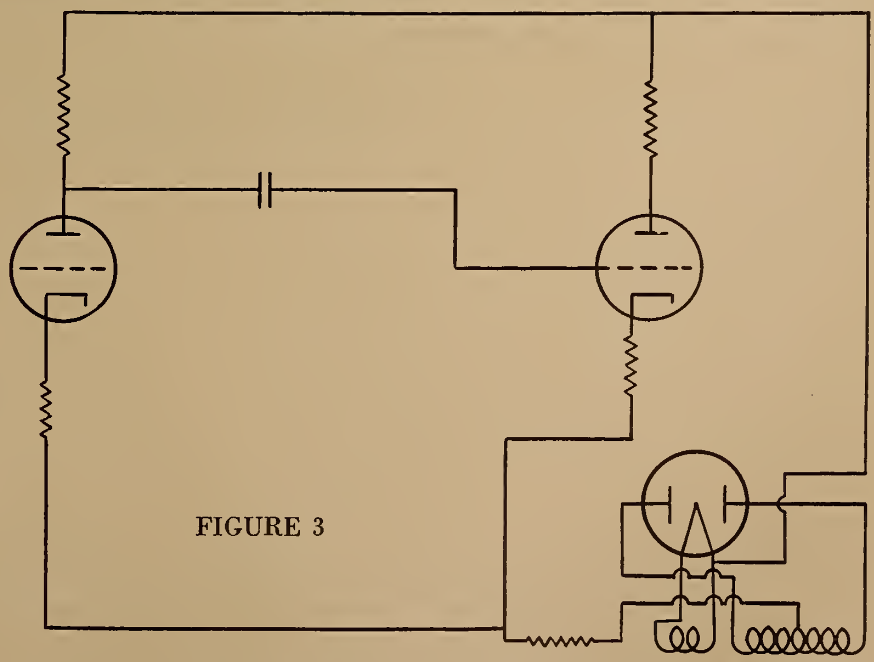


FIGURE 3

(*Continued on page 34*)

PROJECTOR LUBRICATION: HINTS ON CORRECT PROCEDURE

By *A. C. SCHROEDER*

WHILE a film of oil must be maintained in the bearings of the projector, none of it should reach the film, nor is there any sense in having a pool of oil on the floor. In the first place, there is no sense in flooding the machine with oil. The only purpose of the oil, and one which it must serve, is to keep the shaft from actually touching the bearing.

Not much is known about what happens in the space between a revolving shaft and the bearing, but those who have studied the subject agree that the oil film is a layer only a few molecules thick. This refers specifically to heavier machinery than a projector, but when we consider that in these heavy machines the bearings are enlarged in proportion, then the bearing loads in the projector (per square inch) may approach the loads referred to.

Consequently, not only do we *not* need a large amount of oil in the bearing, but there will only be the slightest trace of oil in that part of the bearing which is carrying the load. The logical conclusion is, then, that it is useless to "pour" oil into the bearings.

It is known that one drop of oil will spread over an area nine feet in diameter on the surface of water. In round numbers, a drop of light oil will be somewhere around .001 cubic inch in volume, and when spread over a surface nine feet in diameter, this produces a film of approximately .00001 of an inch thick, showing how far a drop of oil really can go.

Assuming that the largest bearing in the projector head has an area of 2.5 square inches (most of them are about one-half that size) and that there is a clearance between the shaft and its bearings of ¼ of a thousandth of an inch, this gives us a volume of about .0006 cubic inch that may be filled with oil. This is a trifle over one-half of what we considered the size of one drop of oil. When the bearings are oiled daily we know that there is already a film over the entire bearing area, so that most of our .0006 of an inch is already filled with oil, leaving very little room for any more. Yet some projectionists flood such a bearing with one "squirt" from an oil can!

It seems to me that oiling the mechanism once a day is quite sufficient. I have removed high-speed spindles, such as the shutter shaft, after a long day's run, and found sufficient oil for proper lubrication. An exception is the friction case for the Powers fire-shutter, which should be oiled more frequently.

Some projectionists think that the oil runs out of the bearings when the machine is idle for some time. It is true that some oil runs out, but it is only the surplus. There still is an oil film remaining. Understand, I do not advocate leaving a machine stand for an indefinite period and then running it without oiling; but the point is that machines are oiled too much in many cases, and it is only very seldom that a machine does not receive enough oil.

The high-speed parts are the ones that "use" the most oil; these parts throw it out due to the speed. It may be advisable to oil some of these more often than the slower moving parts.

Isolated Spots Not Oiled

There have been instances where oil did not reach parts of the bearing because of the angle at which the machine is tilted. The Simplex shutter shaft is such a case. The oil runs down from the hole, but there is also a part of the bearing toward the back of the mechanism which is at a higher level than the oil hole, and it may happen that this part is "oil-starved."

The vertical shaft in the Simplex is another instance, although this turns comparatively slowly. The oil may run out of this bearing, but it is inconceivable that the bearing will ever become dry, unless, possibly, it is left standing for months.

When we consider a new machine our previous line of reasoning does not hold. It should be oiled often and copiously. Here is one case where I advise pouring the oil on. Even then a bearing may "freeze" up. This sometimes occurs on machines that are not considered new any more. I have seen a shutter shaft and also a Powers drive freeze after more than six months running. From this it can be seen that the oil situation requires careful thought on the part of the projectionist.

Then there is the question of the kind of oil to use. Personally, I prefer a white dynamo oil. It is a very light oil, but not so light as some of the patent oils that are sold under various names. Years ago we used Three-in-One oil on the Powers machines, but this was because we had to crank them, and this light oil certainly made it easy to "push the crank." I believe that an oil like this does not have enough body for our class of work.

Some of the boys have used automobile engine oil, but that practice stopped some time ago. It is too heavy for a motion picture projector, and it makes an awful mess wherever it gets on the projector head and on the floor.

Castor Oil Unsuitable

One of the studios had so much trouble with movements that would not hold oil that the chief projectionist decided to try castor oil in them. This bas effectively stopped the leaking, and so far there have been no bad effects from it. However, it seems that castor oil is extremely thick and viscous for use in a motion picture projector.

Of course, the oil should be constantly wiped up. The head soon gets into poor condition if it is not cleaned up every day. This is not a hard job. You will notice that there are certain places where the oil forms a drop, and then it drips. Several times during a shift a rag should be run over, or, rather, under, these drops, and this gets most of it. A rag run under the back end of the sprockets collects quite a bit of oil, and this is where it gets onto the film. The oil runs out of the bearing and gets on the back face of the sprocket. Centrifugal force then throws it out to the teeth and it gets on the film.

Most of the oil on the back of the Simplex lens seems to get there when the film trap door snaps shut. The surfaces where the film trap and the film trap door-holder contact when the door is closed become covered with oil, and as the door-holder snaps against the opposite surface with a great deal of speed, some of this oil is thrown out almost in the form of a spray, particles of which reach the lens. I have found that much of this can be avoided by keeping these two surfaces wiped dry.

One of my pet "gripes" is oily magazine spindles. Every time one threads up one gets a smear of oil on his hands from the spindle. This is easily avoided by giving them a wipe with a rag occasionally. These are the slowest-moving parts in the projector, so they do not require a great deal of oil; but on the other hand, they carry a greater load than any other part, so do not overlook them during the process of oiling.


MAGIC VOICE
OF THE SCREEN

THEATRE FILM FIRES: NOTES ON PROJECTIONIST PROCEDURE

By *STANLEY E. ANDERSON*

SECRETARY, LOCAL UNION 457, SUPERIOR, WISCONSIN

SPACE is at a premium in a projection room during a film fire, but no more so than is the space provided by I. P. in which various members of the craft may express themselves upon timely subjects. These few words are strung together in the hope that they may succeed in chiseling some of this valuable space anent a topic that is scorchingly close to the projectionist.

Since W. G. Woods of San Francisco is credited as donor of the "springboard" from which I. P. took a plunge on the topic of projection room safety,[1] it isn't asking or expecting too much from the rest of us to furnish some support in the way of a medium in which to swim.

None of us wants to be involved in a film fire, and particularly not within the close confines of a projection room. The topic of fire prevention during projection has been dealt with at length, but most of this material related to existing rooms. Why not a little thought on this subject prior to construction of the room? And why not equal concern for the comfort and safety of the *projection crew* as for the protection of the room itself and its equipment? We're willing to worry about the insurance company's stake in a theatre, but we might worry a bit more about the insurance companies' stake in our own policies, written at sky-high rates.

This business of "the show must go on" is great stuff—for banquets and other festive occasions; but its implications to the projectionist at the time of a room fire are pretty far-reaching. Just because horses and mules attempt to remain in, or even return to, a burning building, I see no reason why projectionists should emulate jackasses and do likewise. What about the audience? Well, what about it? Its chances for escape are far and away better than ours. This show-must-go-on fever is great stuff, but hardly useful to a corpse.

Everybody will concede that few projectionists would remain inside during a room fire if the opportunity for escape presented itself. Hence the current agitation for two-door egress. Even with a double exit the chances are excellent that the crisp body of some hardy projectionist will be found midway between two exits, having been unable to pick either within the few seconds allotted.

[1] *"Sectional vs. National Legislative Effort as an aid to the Craft,"* by W. G. Woods; I. P. for January, 1937, p. 23.

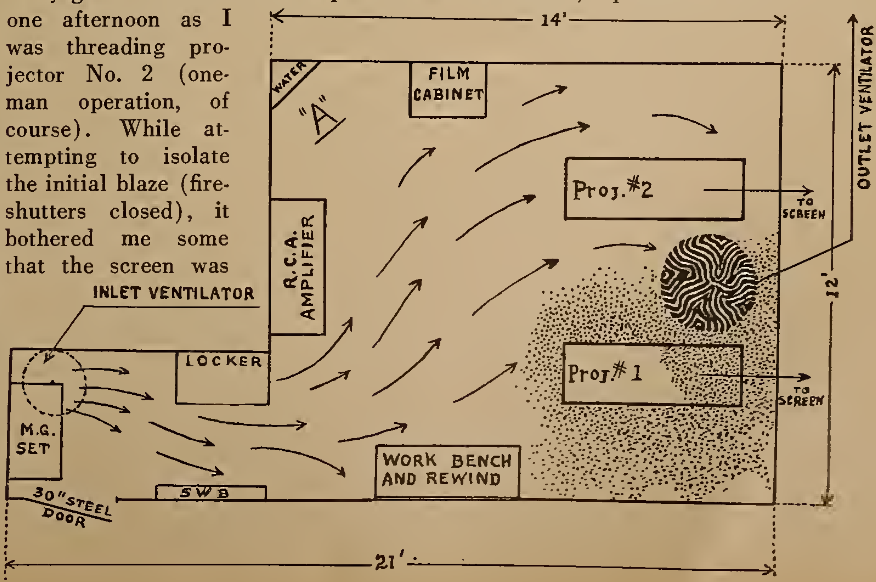
I should like to unloose a few comments anent the accompanying drawing of my present projection room, which is the result of a fluid, workable spirit of cooperation between owner and projectionist in the matter of room construction. Layout, dimensions, arrangement of equipment—yes, and even the type and make of sound equipment—all were left to my discretion. This advantageous understanding was arrived at when I sold the owner on the idea that a well-informed projectionist was in a position to know more about projection requirements and crew safety than anybody else.

True, there are many rooms with much more floor space than is indicated in the drawing, but mere floor space isn't everything. Many rooms amount to nothing more than elongated hallways or expanded rooms, with a couple of projectors installed therein on a catch-as-catch-can basis. Such layouts *need* two exits.

Close-Up of a Room Fire

I have had a couple of film fires during my sixteen years of projection, plus the unique experience of "testing" and "observing" the advantages of a projection room arranged and constructed according to the accompanying drawing. We know from sad accounts what some other arrangements have occasioned. Every projectionist dreads a film fire; but the law of averages seems to produce one every now and then—and always unexpectedly. There are no alarms or warnings for this happening.

My great moment in this respect came one afternoon as I was threading projector No. 2 (one-man operation, of course). While attempting to isolate the initial blaze (fire-shutters closed), it bothered me some that the screen was dark. Even after I had scorched my hands I concluded that I had better pacify the audience with a picture. So I hopped over to No. 2 machine, which had been threaded, started same, and opened only the small lens-port fire shutter. The picture hit the screen; and I settled back between the film cabinet and the sound amplifier (at "A" in drawing), to observe just how 1800 feet of film performs when out of character.



What a show! Such close-range viewing of a film fire would be impossible in the average projection room—that is, if the "student" desired to live to tell about it. The drawing indicates the approximate area covered by flame, smoke and gases and also the density of the smoke. "A" on the drawing indicates where I took my stand for higher education in film fires. What a roar! Perhaps I imagined it to be louder than it actually was, fearing that the audience might become aware of what was happening. With the crackling, the expanding flame and gases and the popping of light bulbs it was a sight to behold.

Heat? Yes, the room warmed up considerably, but the open rewind finished its work with the previous reel unscathed. This reel was then placed in the film cabinet, *the blaze continuing*, and the other projector continuing to carry on the show—the audience being none the wiser. Naturally, all this takes longer to tell than to happen, but at this point I stepped out of the room and told an usher to call the fire department (insurance precaution, *etc.*). Until this moment not even the house crew knew there was a fire in the room.

A film fire in itself doesn't last very long, so when the fire department arrived I had already removed the reel of film ash and was cooling the upper magazine, where the flame had finally concentrated. To the astonishment of the firemen, I proceeded to blow out the

remaining debris and thread the "hot" projector—and still had five minutes to go before the next change-over! Contrary to recent statements, in I. P. and elsewhere, that projector film magazines be left closed in case of fire, I contend that burning gases are less destructive when unconfined; the magazine door was open during the fire cited here, which occasioned only the loss of machine paint.

I attribute this ability to carry on safely and calmly in the face of a film fire to the structural dimensions of the projection room and the arrangement of the ventilation system. The latter consists of a 15-inch, forced-air input in the generator room ceiling, an open archway between the generator room and projection room (no door), and a 30-inch exhaust ventilator in the ceiling between the projectors. This exhaust extends up about 10 feet to the open air, increasing to 40 inches at its top.

Rules of Procedure Futile

These two vent openings are indicated on the drawing by two large circles, marked "V". The arrows indicate the path taken by the forced ventilation. It is evident from this arrangement that one can reach the exit away from a fire at either projector, rewind, film cabinet, or all four places for that matter, and have fresh air blowing in his face all the way out; while at the same time the flame and smoke are concentrated at and confined to the area of the exhaust at the opposite side of the room.

As for drawing up a set of rules of conduct for the projectionist in case of fire, they would be about as effective as a set of rules governing the conduct of a motorist on a one-cowpath country road. I venture the assertion that in a properly constructed projection room, if there is nothing but the film to be destroyed, one might as well not waste the contents of the fire extinguishers.

[NOTE: I. P. has its own very definite opinion as to the efficacy of both Mr. Anderson's room layout and ventilation and his own conduct during the fire he describes. Moreover, the author's inconsistency is very apparent: early in his article he states that a projectionist's first duty is to himself—never mind a few feet of film and a few bits of equipment. Subsequently he describes how he remained in the room and watched the progress of the blaze.

I. P. should like to withhold its own opinion, however, until the field is heard from. Mr. Anderson favors opening the mechanism doors during a fire—rank heresy, indeed, and contrary to an accepted principle of long standing. This point alone should net a raft of comments. Let's have them.—ED.]

Rapid Print Transit and No Instruction Causes of Inept Exchange Work

The author of the appended article must remain anonymous because of his present employment, which might be endangered if his identity were made known. He confirms I. P.'s original statements anent the long hours and overwork of exchange employees, and points up the fact that inspectors know little, if anything, about the requirements of their work—nor are they given any instruction. To I. P. from all over the country came hundreds of film clips, reproduction of which would serve merely to labor the point, already definitely established, of inefficient exchange procedure.

MUCH has been said as to what constitutes good exchange inspection and as to who can be blamed for the mutilation of projection prints. I feel, as do many others, that there has been too much "passing the buck." I have had experience in both exchange and projection work, thus the article, "Can a Girl Inspect 2¼ Million Frames a Day?" in I. P. for March, interested me greatly and prompted me to try to give an inside picture of what is going on.

The people who work on "film alley" comprise a hard-working, conscientious group who put all they have into their job for a meager return. What they do is usually well done; but lack of information and instruction cannot be blamed on them. I venture to say that not five out of a hundred inspectresses, shippers, or any other persons directly connected with the care of film in the exchanges, have ever been inside a projection room, or even have any idea just how the film is used in the theatre. The exchange heads are to blame for this disgraceful situation. Few instructors are ever supplied to teach methods new or old. The policy has been to let a new girl "just sort of learn" from the head inspectress or anyone who has time to teach her, in the rushing, pulsing business of getting the film out to the theatres.

Total Lack of Instruction

There is never any instruction as to the proper way to paint the sound track after making a patch. They know the sound comes from the sound track, but they don't have the faintest idea how, and a bad painting job looks just as good as any other. Of course, we know that a bad one is worse than none at all. Alignment of patches means nothing to them as long as the patch holds together. Why should it? they have never seen the various and sundry gadgets men have been putting on machines for years to keep film running smoothly over fast-moving parts. While some few know that over-scraped patches mar the effect of projection, others say let it go as long as it holds together. They are pushed so hard on shipments that often they don't have time to make necessary replacements.

In the majority of exchanges the film, if of any box-office value at all, is booked so close that often there is only time to get the print off the incoming truck, put a shipping label on it, and put it on the outgoing truck. One of the biggest sources of film mutilation is caused by the film being poorly rewound on the reels in such a manner that some of the edges are left sticking up. In this case the weight of the other reels in the container causes these edges to be crushed and broken. The distributors blame projectionists for this mutilation. Distributors contend that if they send the film out on new reels, projectionists will steal them and send back old ones. That may be so; but I have yet to see an exchange reel, new or used, that any self-respecting projectionist would keep.

I doubt if anyone on "film alley" ever heard of "I.P." (such heresy!—Ed.). I have run across inspectresses who thought it was a good thing to coat a print with heavy vaseline. You can imagine the grief of the poor fellow who ran such prints. Between the green emulsion and the vaseline, his apertures must have looked like the hind wheel of a buggy with all its axle-grease. It is a not uncommon thing to see an inspectress hold the end of the film tight and "pull the reel up" after rewinding loosely. Between the dust collection and the friction it doesn't take much of this, no matter how well a print is processed, to make the projected image simulate a cloudburst.

Prints the Only Merchandise

An exchange manager is angered if his desk is not dusted daily; but he thinks it unnecessary to clean his film prints. A print is improved if it gets even one good cleaning. They all seem to have gone mad on the subject of advertising and exploitation; but they forget that the biggest advertisement is the picture the people see. The projection print seems to be the step-child of the exchanges, is kicked around any old way, when it really embodies everything that the producer put into his work and everything the distributor hopes to get out of it. The sooner the exchanges learn to handle film properly the sooner the doubtful gains from film neglect will be overshadowed by genuinely earned returns.

Organized projectionists are fortunate in being able to acquire up-to-date in-

formation on what is going on in their phase of the industry. This statement is substantiated by the many improvements and inventions that have come from the craft itself. Plainly speaking, "they know what it is all about." There is no attempt on the part of the craft to tell the distributors how to run an advertising campaign; but the lack of knowledge about the film itself in exchanges is pathetic and, I believe, merits sharp criticism. Now that the exchange workers are being organized, the union projectionists should take a hand in showing them what is expected of film classified as a good print. There is no need to teach them how to project, but only to teach them how to inspect from the projectionist's standpoint, which after all is the logical one.

Don't blame the inspectress — she doesn't know any better. Just get one of those bookers, who thinks celluloid wears like iron, and that prints live as long as Methuselah, to look at one of his pictures in a second- or third-run house, and I believe he will think twice before he lets a defective print go out.

NEW FIELDS FOR PROJECTION EQUIPMENT AND EMPLOYMENT

By *WILLIAM K. NELSON*

WHILE experiences of many office buildings which have been equipped with sound motion picture projection facilities for the benefit of tenants and others have not been as satisfactory as might be expected, there is plenty of evidence available that such facilities will in the end pay out on the investment, directly and indirectly. In the main, auditoriums so equipped, especially in New York City, have not been exploited fully by the building management, with the result that rental fees have failed to provide sufficient revenue to cover the investment.

It is generally believed, however, that the rapidly increasing use of the sound picture screen by large corporations and associations both for purposes of training and entertainment, will make office building projection rooms profitable in both terms of earnings and of publicity and tenant service. The possibilities of making such a projection room pay are great providing the management of the building knows how to secure rentals and aggressively sets about to sell them.

In most instances where the skyscraper projection room has been somewhat of an elephant, the management has installed it and looked upon it as a service feature, designed to accomodate tenants using or interested in using the sound screen.

Aggressive Selling Required

There are few buildings, even in the larger cities, which could sustain the overhead on such a setup without bookings from outside sources. This has been true in the Chanin and the Daily News buildings in New York and others. A plan of business development plus a fair but adequate showing fee will produce enough revenue in the average office building theatre to make it at least self-sustaining.

Where is this screen time to be sold? Roughly speaking, the office building management will find its revenue among these groups:

Commercial motion picture producers, for showings before prospective picture users.

Commercial motion picture producers, for showings of customer productions before customers organizations and customer's customers.

Associations of all kinds which use pictures in their advertising and propaganda work.

Building tenants using pictures in their business.

Advertising agencies, many of which now maintain commercial picture departments but do not have sound projection facilities.

Entertainments.

Important Cost Factors

The matter of charges is, of course, an important one. I find that they vary greatly in buildings of the same type and size, and in buildings with the same equipment. Usually, a charge per reel is made, though in one instance the charge is based upon the period of time for which the facilities are rented.

One of the chief difficulties lies in the necessity to maintain a competent projectionist on hand at all times. However, in every large city recourse can be had

(*Continued on page* 31)

RUDOLPH MIEHLING

In Remembrance and Appreciation of Fifty Years' Friendship

THE death of Rudolph Miehling on April 6 marks the passing of a unique and outstanding figure in the motion picture field. It is customary to think only of great actors, great producers, directors and theatre men when we record the loss of one who has occupied a prominent place in the pioneering period or later tremendous development of the motion picture industry. But Rudolph Miehling, too, was an historical figure because he was a pioneer projectionist who helped solve many technical problems connected with the early and later devolpment of projection.

Some one has noted that little of importance was contributed to the early development of projection by any engineer in the professional sense of the word; and there is much truth in this. Rudolph Miehling was the exception, however, for he was a graduate E. E. from Columbia University. But he had something more than a degree or mere theoretical knowledge. He was a real showman at heart.

Many years ago, when a roadshow found itself in difficulty because of the lack of a rheostat, Rudy hastily rigged one of those "water-barrel rheostats" which were the last resort of not a few ingenious "operators" in those days. Such devices were typical of the manner in which pioneer projectionists like Rudy overcame the innumerable obstacles encountered.

Rudy worked as a projectionist in a New York City Loew theatre up to the time of his last illness. He was a charter member of I. A. Local 306 and maintained this affiliation through all the years of his life. Technically, Rudy was always a projectionist, despite his wide and varied experience dating from one of the first "Birth of a Nation" roadshows. Later he was with Kinemacolor, after which he served as chief projectionist at the Capitol Theatre in N. Y. City under "Roxy". He was employed by Bell Telephone Laboratories on sound picture development, and was one of the first Erpi engineers when that company was formed. He also served as assistant to Harry Rubin in the servicing of projection for more than 1000 Publix theatres.

Rudy was a member of the Society of Motion Picture Engineers, the American Projection Society, and was particularly helpful in the development of the Projection Advisory Council. His work in the Projection Practice Committee of the S. M. P. E. in recent years was of inestimable value He was a member of Antiquary Lodge, A. F. & M.

Certain conditions connected with the death of Rudy Miehling keep me from systematically noting the incidents connected with his long years of service. For if others knew Rudy better than I, none knew him so long. Fifty years ago we sat together in school, chumming and differing rather positively at times; but through all the years we maintained unbroken friendship and goodwill for each other. Thus, it is extremely difficult, if not impossible, for me to write about his passing and coldly marshal the details incident to his life.

It is enough to say that a very useful life has been taken from the industry in general, and from the art of projection in particular, and that many individuals, not the least of whom is myself, have lost a great, good and true friend.—P. A. McGuire.

PROJECTION REQUISITES OF THE BERTHON-SIEMENS LENTICULAR COLOR FILM

By *EDGAR GRETENER*
SIEMENS & HALSKE A. G., BERLIN-SIEMENSSTADT, GERMANY

In the past few years in Europe the lens-screen method for color films has been further developed. The most active group worked with the inventor, Rodolphe Berthon. Their interests are embodied in Opticolor A. G., Glarus, Switzerland. At the request of this company, Siemens & Halske A. G. (Berlin), in connection with other firms, developed the method into an industrial process. It has received the name Berthon-Siemens Color-Film Process. During the 1936 Olympic games a short film, made by this process, was shown publicly in Berlin. It is believed that this represents the first time in the world that a lens-screen color-film (35-mm.) has been shown successfully on a motion picture theatre program. Additional films are being made.

THE light requirements for projection of lenticular film are about *ten times as high* as those of the black-and-white film. The losses occur in the reproduction filters and through the reduction of aperture necessary to overcome vigneting of the illumination and reproduction systems. Besides the necessary increase in intensity of the projection light, special requirements are created as to the quality of the illumination in the projector aperture.

The illumination systems used at present for black-and-white film all produce light rays with energy distribution that varies for different angles of the image field. The only necessary condition for black-and-white projection is an approximate proportionality of energy in the light rays belonging to the individual image points. This alone fulfills the condition of approximately constant illumination of the whole image field.

The special conditions for the illumination of the lenticular film have been fulfilled by creation of a new type of arc lamp. Considerable increase in the efficiency of illumination was attained as compared to present illumination.

For small theaters a pure carbon arc was developed. In accordance with the form of the picture aperture, square carbons are used. A stabilizing arrangement at the hot end of the positive carbon effects the concentration of the total discharge upon the front surface and protects the shell from oxidation. A magnetic field of a special type, with its axis parallel to the carbon axis, takes care of the stabilization of the arc. It is constructed so that rotation of the total discharge takes place at such high frequency that the homogeneity of the crater for the illumination time of a single frame is assured.

The space stability of the crater is so great that only a small safety margin of the crater image over the film-gate area is required. The positive and negative carbons have a common horizontal axis. The thermal lifting force on the arc is practically equalized through the electro-dynamic forces of the stabilizing field.

Large theaters use high-efficiency lamps of very high intensity. Here also, new ways had to be found. In the existing high-intensity lamps, employing the Beck-effect, a deeply burned-out crater prevents the reflection of the luminous gas ball to the sides on account of the high crater walls. A considerable part of the current goes to the carbon shell, and is therefore lost for light production. The light-intensity distribution is not homogeneous, and is disturbed by flames emerging from the space between the shell and the core.

In the newly developed high-efficiency lamp[1], square carbons are used. The lamp burns with absolute freedom from soot. An intensely luminous gas ball is visible which extends well in front of the positive carbon and therefore can radiate laterally without obstruction. The flame gases are absorbed by a cover surrounding the negative carbon and escape through the bore of the reflecting mirror. In order to give an idea of the efficiency of the new lamp, it may be stated that with a current of 60 amperes, the density (intrinsic brilliance) in the crater was measured as 800 candles per sq. mm.

[1]Conventional Suprex-type arc.

Further increase of screen brightness above the limit reached with the new lamp could be attained by development of a special projection screen. The screens that are at present in common use in motion picture theatres, and which provide diffuse reflection, throw a great deal of the light from the projector upon the ceiling and the walls of the theatre. The new reflector type of screen reflects the light only in those directions in which it is intended to go. Metal sheets are used in constructing the reflector, and small concave mirrors are rolled into them of such form that the desired diffusion diagram is obtained. The dimensions of the elementary mirrors must be kept very small, so that *one million elementary mirrors are present in one square meter.*

On the basis of present conditions in German motion picture theatres, an increase of screen brightness by a factor of 3 can be obtained through introduction of the new screen. The precision requirements of the elementary mirrors and the uniformity of impregnation must be extremely high, since otherwise changes of brightness appear at the borders of the individual metal sheets.

Upon projecting a color-film, the viewing conditions are different from those when the object is viewed directly. The colored image appears luminous in a black frame. The connection with the surroundings is missing. The change from one scene to another occurs in jumps, so that the eye has no time to adapt itself to the changed mood. If pictures taken under varying conditions of illumination are combined into a single film. one gains the impression that, for

(*Continued on page* 30)

A Fine Travel Book by a Boston Projectionist

I don't recall any projectionist who ever won a Nobel prize for literature, or even an Academy award for a scenario, but I am faced with the evidence that Arthur Foley, projection chief at the RKO Theatre in Boston has written one of the most engaging travel books ever to fill my vision. The book is titled "Breezy Adventure," and a more apt title could not have been selected, so racy and invigorating is this narrative of travel on two continents. Travel books usually are soporific in their tireless chant of architectural attainments and native customs, all of which Mr. Foley ducks to indulge in some pretty stiff and straight sentence-punching anent those experiences which befall a traveler with the will to have fun and to avoid the commonplace.

The charm of Mr. Foley's work lies in its ability to make one forget the book and imagine the author sitting opposite and reminiscing over a spot or two of this or that. The bleak printed page is blotted out and supplanted by a warm and human personal exposition of carefree travel days in Europe, in Northern New England and in Canada.

I dipped into the book with only a mild curiosity; before I had finished it, in one reading from which I could not tear myself away, I was proud to have a copy of this work inscribed to me by the author. Published by Bruce Humphries, Inc., 306 Stuart St., Boston, this book of 213 pages sells for $2. It will give ten times that amount in pleasure.—J.J.F.

THE PUSH-PULL SOUND RECORDING AND REPRODUCING SYSTEM

By *FRANK T. JAMEY, Jr.*

FOR the past few years there has been considerable publicity given to a newly-developed system of recording and reproducing sound on film. This new method has been represented as being a definite step in advance, and for this reason, there has been some speculation as to why it has not already reached the theatre. Before we analyze the reasons for this let us consider just what is involved in the recording and reproducing of this new type of recording.

When sound motion pictures were introduced it at once became evident that considerable progress would have to be made to eliminate the extraneous and objectionable noises that came from the loudspeakers in the theatre reproduction of sound from film. At that time the most important cause for such noises was the large amount of transparent sound track on the positive print. Any dirt or oil which might find its way on the sound track, thus intercepting some of the light that should have reached the photo-cell, would certainly occasion such noises. In addition, some extraneous light reached the photo-cell.

In 1929 the introduction of ground noise reduction equipment, which essentially reduced that amount of useless transparent sound track, permitted a material reduction of the extraneous and objectionable noises.

Even after this important development there was plenty of room for further progress. Recognizing the objective of reproducing sound in the theatre that was directly comparable to the sound originally created in the studio, engineers realized that 1930 sound quality fell far short of this goal. The reproduced sound was not sufficiently realistic because too many of the important harmonics were missing, and also, it still was impossible to reproduce the sound in the theatre at the amplitude or volume level comparable with the original.

A Two-Headed Problem

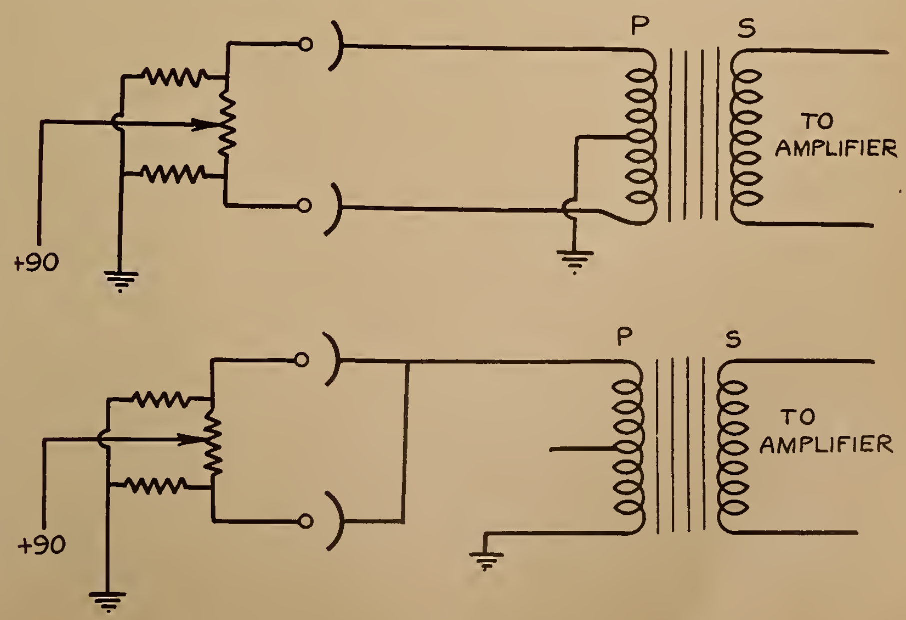
The research engineers found that this problem could be attacked in two ways. First, it was necessary to refine to a considerable degree each individual unit of a complete recording and a complete reproducing system. Second, it was essential to develop a new system of recording which would permit an even further reduction in ground noise.

Late in 1932 the first stage of this engineering development was sufficiently completed to permit the introduction commercially of recording and reproducing systems for extended frequency and volume ranges. The recording and reproduction of a frequency range of 40 to 10,000 cycles per second, with reasonable uniformity and a volume range of approximately 50 decibels, resulted in sound in the theatre that was startlingly realistic. For the first time voices assumed a naturalness that permitted the auditor to recognize them without closely watching the lip movement, and musical instruments could be heard individually with a quality easily comparable to the original. While the results of this development were widely recognized and exploited, it was evident to the engineers that the second stage was still as important as ever. Two years later this work was completed and the new system of recording known popularly as "push-pull" was introduced. The volume range was thus extended to about 65 decibels.

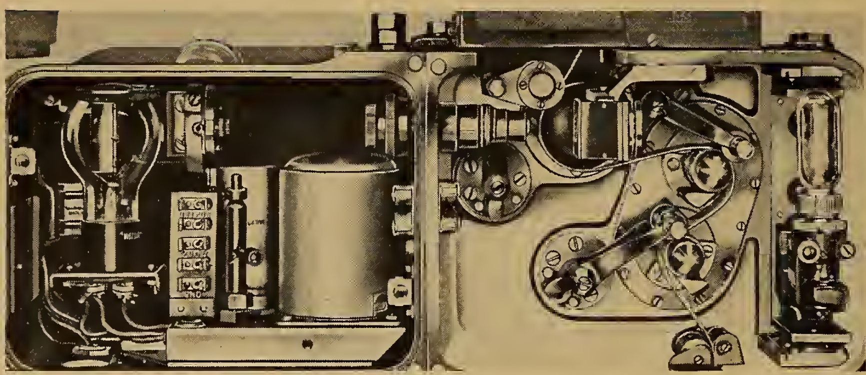
Push-pull recording involves the splitting of the standard sound track on the film into *two sound tracks* which occupy the same space on the film (76 mils). The tracks are split so that all the *positive* halves of the signal waves (alternating current waves) created by the microphone and amplified are recorded on one track, and all the *negative* halves on the other. Each track is 35 mils wide, and they are separated by 6 mils in case either overshoots. This is accomplished in the recorder by using a mask which exposes one track for the positive halves of each wave, and the other for the negative halves.

To reproduce this type of recording few fundamental changes are required to the standard reproducing system. The light beam from the exciter lamp is accurately focused on the sound track so that it scans a width of approximately 84 mils, overlapping the track on both sides. When a push-pull track is thus scanned, two varying beams of light eminate from the other side of the film. These must be *separately* converted into electrical waves by being directed to *separate* photo-cells.

A full signal wave consists of 360 degrees. Since only half of each wave is on one sound track (180 degrees), it is evident that the tracks are 180 degrees out of phase with each other. As electrical waves, then, they must be properly mixed before being amplified and converted into sound waves. This may be accomplished by connecting the cathodes of the photo-cells to opposite ends of the primary winding of a photo-cell transformer, and the common connections to the center tap. The waves are then mixed in proper relationship and the two tracks are added together



Comparison of circuits: Above, push-pull; below, standard



The Erpi (W.E.) Mirrophonic push-pull sound head

to give the proper and desired results. This type of transformer connection is known in radio as a "push-pull" connection—hence the name.

Inexpensive Modification Possible

Some soundheads that have been installed for the past few years can be inexpensively modified for reproducing a push-pull sound track. In the case of most of the heads, however, this is not so easy. Both RCA and ERPI are today in a position to furnish soundheads already equipped for reproducing either standard or push-pull tracks. In many respects they are similar.

Instead of utilizing valuable space by employing two separate photo-cells, a new type of double photo-cell has been designed which contains two separate cathodes in one envelope, each individually excited. This photo-cell is placed in the position regularly occupied by the photo-cell, with an optical system placed between the film and the cell so that each of the light beams is properly directed to its cathode. The electrical connections from the photo-cell are wired to a switch and to a balancing potentiometer of the screw-type located in the film compartment of the soundhead, and then to the special transformer located in its ordinary position.

It is possible to connect this apparatus so that with the switch in one position, standard track may be reproduced; in which case both photo-cell cathodes are paralleled, since half of the track reaches each cathode, and are connected regularly to the opposite ends of the transformer primary winding. With the switch in the other position, push-pull recording may be reproduced by connecting each cathode in a push-pull connection as described previously.

The problem of properly directing the light beams to their respective cathodes is dependent on space conditions and the location of the photo-cell. In the RCA soundhead a photo-cell is employed, mounted horizontally, which has two cathodes rectangular in shape, one above the other. Since the two sound tracks are side by side, with the result that the two light beams are alongside of each other in a horizontal plane, it is necessary to twist the beams so that they will be one above the other as well as properly directed to their proper cathode. This requires some intricate prisms, particularly considering the small space available.

The ERPI soundhead uses a photocell, mounted vertically, whose two cathodes are alongside each other in a horizontal plane. Thus it is not necessary to twist the beams. Double photocells are available with the ordinary cathode split in half, so that even if it is mounted horizontally it would not be necessary to twist the light beams, but it would be necessary to separate them a bit so that each would strike the middle of its cathode.

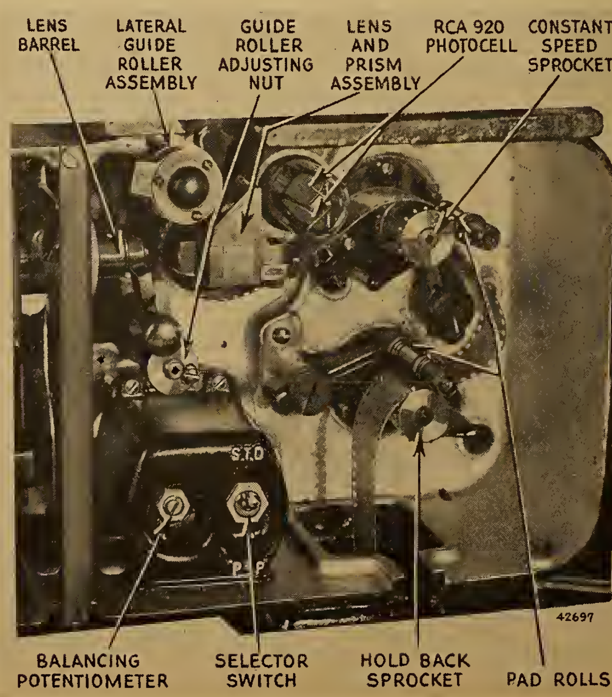
Principal Adjustment Required

The principal adjustment that is required of this equipment for satisfactory results, in addition to placing the switch in the proper position, is to be sure that the output of the cathodes are balanced. This is accomplished by balancing the excitation voltage with the aforementioned potentiometer. To do this one runs some standard sound track recording (any type except unilateral variable area) through the projector, placing the switch in the "Push Pull" position. In this way you will be directing exactly similar light beams of one-half of the track, which for symmetrical variable area or for variable density give equal beams. When the outputs of the cathodes are properly balanced the sound output will be as near zero as possible, as the beams will be cancelling each other, since they will be mixed, 180 degrees out of phase with each other. It is at all times necessary, of course, that the beams be properly directed to their respective cathodes; but once set in the factory or by the serviceman, no further adjustment of the optical system should be required.

The push-pull method of recording sound on film has made possible the most extended volume range yet achieved. This is due to the elimination of the highly critical ground noise reduction equipment in the recording process which the recordist finds difficult to always keep properly adjusted, particularly when temperamental directors, actors, and stage crews are anxious to make a "take." Furthermore, this type of recording reduces to a theoretical minimum the amount of sound track exposed. Since only the useful portion is exposed, the opportunity for dirt or oil to intercept the light beam in the reproducer is almost entirely eliminated.

Less critical processing of the film is required with push-pull recording, because with the halves of the waves on

(Continued on page 29)



This view of the RCA High Fidelity soundhead affords an excellent comparison with the Erpi head pictured above. Note particularly the lens and prism assembly used in this head

The IP EDITORIAL PAGE

Vol. 12. No. 4 APRIL 1937

Color Pictures: An Opportunity and a Risk

Color is the current darling of the motion picture industry, which has ever been prone to rush away from one job badly done to tackle another. Black-and-white reproduction is pretty bad in more than one-half of U. S. theatres, yet the reproducing mechanism is to be saddled shortly with another and greater burden—color. Color motion pictures intrigue us, particularly in the reproduction phase, and we have been grabbing for publication almost everything relative thereto that we could lay our hands upon. This material has ranged from extremely good to extremely bad; and some of the funniest stuff, judged from the viewpoint of the known limitations of present projection equipment, has been pushed out by proponents of the lenticular color film process, who are enjoying a field day right now. This process has been discussed herein (Aug., 1936; Jan., Feb., March, 1937).

Grand National, one of the newer producing companies, plans to utilize the Keller-Dorian (lenticular) color process, which requires a filter in projection. G.N. at the moment is trying to decide just how they will service theatre accounts with filters on color releases. We pray for an early decision in this direction, but we fear that even when made the decision will have no practical significance.

We have seen lenticular film projected under ideal conditions before an engineering group. To suppose that even the de luxe theatres could approximate these ideal conditions is akin to wishing for the moon. First, there is a little matter of pepping up the projector light output by 400%. Eastman Kodak Co. claimed to have attained this goal; but many projection men were skeptical. Next, a lens faster than $f/2$ is required, and it is necessary to fill this lens completely. Then there is the question of horizontal lines, the result of the lenticulations, manifesting themselves on the screen, due to magnification. The nature of the color itself is O. K., but for projection it is necessary to stop the blues down. The projection lens must have a special holder, and the filter must be fitted with a key to insure proper fit. This filter, incidentally, is positively not adaptable to an ordinary lens. Negative carbon pitting requires the removal of the arc away from the condenser, despite the utilization of a special non-pitting fin developed by Hall & Connolly.

These are some of the problems incident to the projection of lenticular color film. Other problems were enumerated by Messrs. Capstaff, Miller and Wilder in I. P. for Jan., 1937, p. 20. Acceptable reproduction of such film might be accomplished on a small theatre screen, provided the illumination has been hopped up considerably; but in a theatre having 16-, 18-, or 20-foot screens there is insufficient light.

This, then, is the manner in which the motion picture industry is planning to introduce a new color process. Once these color releases start circulating, smart projectionists will undoubtedly uncover other serious defects not apparent to one sitting at a desk instead of ranged alongside a projector. Evidence is not lacking that the industry was a bit premature in exhibiting certain color releases which were away below par. The public was badgered by terrific ballyhoo into expecting magnificient color pictures; and what they finally saw was something less palatable than a cold pancake. Not yet has there been released a feature picture in color of which the industry could be unreservedly proud. Disney does it consistently, to be sure, but his cartoons lend themselves naturally to color treatment. A feature picture is really a screen halftone, and cartoon technique is not applicable.

The results of all this muddling in color will do the industry no little harm, and might possibly induce a knockout blow from which color pictures will not recover for a period of years. Color pictures certainly are on the way; and nobody will welcome them more enthusiastically than this corner. But they must be good. It is not enough to lick the problem of color film production in the studios where every step in the process can be and is subjected to the most rigorous control. Projection problems of a type enumerated previously must be overcome—and first.

It is wholly unfair, if not incredibly stupid, on the part of producers to expect that they can use the theatres of America, which charge admission, as laboratories wherein color film problems will be worked out on the basis of trial and error. Should they adopt this course (and it appears likely that they will) one can only shudder at the havoc that will result—not only through the discrediting of color pictures but to the industry as a whole.

New Mass. Rules a Credit to an Energetic Group

We have just finished inspecting the new regulations governing motion picture exhibition promulgated by the Massachusetts Dept. of Safety. These regulations are sane, sensible and eminently fair to all concerned, *not excluding projectionists*. We like them so much that we will publish them in detail at the first opportunity. Here is another fine job by Local 182 of Boston, which also was the first group to jump in and tie up the exchange workers. While projection units throughout the country were meekly saying "Yes" to requests that they O. K. the double-reel standard, Local 182 battled the proposition down to the bitter end. In the end they bowed to the inevitable on the reel project; but they gave nothing away without getting something in return—which was precisely what I. P. advised all other units to do. If one assumes that in losing the reel fight Local 182 gained the regulations now in effect, one might wish for similar "defeats" for projection units throughout the country. Those interested in a model set of rules relating to motion picture exhibition should obtain a copy of the Mass. regulations.

Exchange Work Improvement By Unionization

Our article on exchange film inspection last month elicited no response from those who might be considered to be most vitally interested in such matters. That the article would accomplish at one fell swoop that which has been attempted for so many years was not expected. Still, it is well to get such information into circulation, even if only for the record. Both the M.P.P.D.A. and the Academy, as sponsors of the long reel standard, have a definite obligation to the industry in effecting improvement in exchange inspection; but our thoughts in this direction will be unproductive. Strangely enough (that is, from the distributor viewpoint) first improvement along this line likely will result from the current exchange unionization drive, having as two of its objectives shorter hours and a slowing down of the pace.

FORMULAS FOR VARIOUS PROBLEMS IN PROJECTION OPTICS

By *CHARLES D. MERCER*

THE "work" of a lens consists in forcing the wave to assume a different shape or in causing the light to converge toward the focus, instead of, as originally, diverging from the distant source. The amount of this change of form of the wave is a measure of the "power" of the lens and depends on the curvature of the lens surfaces and the lens material. The stronger the curvature of the lens surfaces, the more will they alter the shape of the wave-front, the nearer, as a rule, will the focus lie to the lens.

In order to properly characterize a lens, it is necessary to look about for a measure of its strength or power. The focal point has, in general, a real existence and can actually be located by placing a screen so as to receive upon it the image of a distant object; the size of this image, is, as we shall now see, the true measure of the power of the lens.

It is apparent from the foregoing that the less curved the lens surfaces are, the farther away from the lens will the image lie and the *larger* will this image be.

The power of a lens is often, but sometimes erroneously, measured by the distance of the focus from the lens, or as we may say, by the *back focal distance* (CF in Fig. 1). If we compare two lenses of different forms (Fig. 1 and 2), but so constructed as to give images having the same power, we note that the "back focal distance" is entirely different in the two cases, showing at once that this distance is *not* the true measure of power. The true measure of power is found by measuring the size of the image and the apparent size of the object and finding the ratio mentioned previously.

If we divide unity—that is, one—by

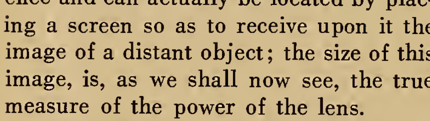


Figure 1

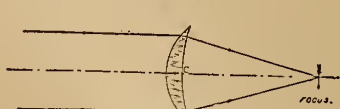


Figure 2

this ratio, we have what is known as the true or *equivalent focal length;* this is, as we have seen, not at all the same as the "focal distance", often called "back focus".

The power of lenses and lens systems may be recorded either in inches or *diopters*. When the inch system is employed, the focal length of the lens system is taken in inches; an "eight-inch lens," therefore, is a lens which has its sharpest focus at 8 inches. In the dioptric system, a one-diopter lens is a standard lens which will bring rays of light to a focus from a distance of one meter, or 40 inches.

Conversion to Diopters

To convert the inch focal length of a lens or a lens system into diopters, we divide the number of inches into 40. A lens with an 8-inch focal length is a 5-diopter lens by the simple process of 40: 8=5.

Convex lenses (which are thick in the center and thin on the edges) cause rays of light passing through them to converge at a very definite point, as shown in Fig. 3. Concave lenses (which are thin in the center and thick on the edges) cause rays of light passing through them to become divergent, as in Fig. 4.

The lens formulas which find the most frequent application in projection work are those which are employed for the following purposes:

A. To determine the position of screen and type of lens to employ in a given optical system, use the formula:

$$\frac{1}{\text{object dist.}} + \frac{1}{\text{image dist.}} = \frac{1}{f}$$

Given: An object 6 inches distant which it is desired to bring to a focus, we substitute:

$$\frac{1}{6} + \frac{1}{\text{Image dist.}} = \frac{1}{3}$$

for we know from mirrors that if the object distance is more than twice the focal length of the lens, the image will converge at the principal focus. Hence, solving the above:

$$\frac{1}{6} + \frac{1}{v} = \frac{1}{3}$$

or, $v + 6 = 2v$; or $v = 6 =$ distance of image from lens.

B. To determine the size of the image when the object size and the object and image distance are known, use the formula:

$$\frac{\text{Image dist.}}{\text{Object dist.}} = \frac{\text{Size of image}}{\text{Size of object}}$$

Given: An object 4 inches high which

Figure 3

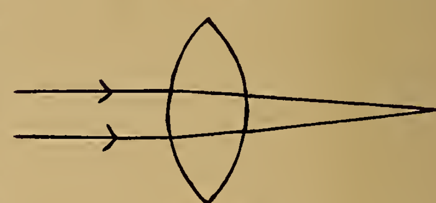


Figure 4

is 8 inches from the lens, the image distance being 24 inches, we substitute:

$$\frac{24}{8} = \frac{\text{Image size}}{4}$$

Hence, solving the above:

$$2\ I = 24, \text{ or } I = 12$$

C. To determine the focal length of a lens when the curvature and index are given, use the formula:

focal length =

$$\frac{\text{radius 1st. side} \times \text{radius 2nd. side}}{\text{radius 1st. side} + \text{radius 2nd. side} \quad (\text{index-1})}$$

Given: A bi-convex lens, one surface having a radius of curvature of 10 inches, the other having a radius of 8 inches, index 1.50, we substitute:

$$\frac{10 \times 8}{(10 + 8) \quad (1.50 - 1)} = F$$

$$F = \frac{80}{18 \times .50} = \frac{80}{9} = 8.88 + \text{ inches}$$

D. To determine the equivalent focus of two lenses in combination when the focus of each lens is given, use the formula:

E. F. = the reciprocal of the sum of the individual focus of each lens.

Given: A 10-inch lens combined with a 40-inch lens, we substitute:

$$E.\ F. = \frac{1}{1/10 + 1/40} = \frac{1}{5/40} = \frac{1}{1/8} = 8$$

E. To determine the size of screen image when the projection distance, width of film gate aperture, and focal length of lens are known, use, with all values in inches, the formula:

$$\frac{\text{Size of image}}{\text{Width of aperture}} = \frac{\text{Dist. from screen to lens—focal length}}{\text{Focal length of lens}}$$

Given: Width of aperture as .906 inches, distance from screen to lens as 1,200 inches, and focal length of lens 8 inches, we substitute:

$$\frac{\text{Unknown screen image}}{0.906} = \frac{(1{,}200\text{-}8)}{8}$$

$$\text{or X, or Unknown Image} = \frac{0.906(1192)}{8}$$

or, 8X = .906 X 1192 = 1080

or, Image = 135 inches = 11'3"

F. To determine the focal length necessary for a given picture when the projection distance, width of aperture, and image size are known, use the formula:

$$\frac{\text{Width of aperture X projection dist.}}{\text{Width of aperture + size of image}} = f$$

Given: Width of aperture as .906, projection distance as 1,200 inches, and size of image as 135 inches, we substitute:

$$f = \frac{0.906 \text{ X } 1200}{0.906 + 135} = \frac{1087}{136} = 8 \text{ in.}$$

ACADEMY RESEARCH GROUP ADOPTS STANDARD FOR 2-WAY THEATRE REPRODUCING SYSTEMS

THE Research Council of the Academy of M. P. Arts and Sciences has issued a Technical Bulletin outlining the changes in adjustment of theatre reproducing equipment necessary in order to adopt the new Standard Electrical Characteristic for two-way reproducing systems in theatres. This is one of the most important and far-reaching technical standardizations since the adoption of the standard aperture in 1931, and will permit the theatre to obtain the advantage of the latest studio sound recording practice and will result in a more uniform sound quality from all producing companies in all theatres.

This Standard evolved as a result of a great variety of sound tests made in a large number of theatres.

As a preliminary stop in their investigation leading to the adoption of this standard, the Academy committee prepared a test reel, containing a 250-foot section of release print from each studio, so chosen that the assembled test reel contained representative examples of both dialogue and music recordings made under average as well as extreme conditions by each studio sound department. The Carthay Circle, Grauman's Chinese, The Filmarte, Oriental, Pantages and Warner Brothers theatres, in Hollywood, were chosen as a test group having divergent characteristics representative of the entire theatre field, the Committee operating upon a premise that a standard which would fit these theatres would in general fit at least a majority of the theatres throughout the country.

Permanent Improvement Realized

In the opinion of the Research Council, this Standard will give the best reproduction of the film product from all studios today, but as improvements are made and the recording characteristics are changed in the studios, similar compensation can easily be made in all modern theatre equipment at little or no cost.

In submitting the report the Research Council stated:

"It has been customary in the past to adjust theatre reproducing equipment to satisfy the ears of individual groups. To obtain these results, test sound tracks of various characteristics made by the separate and many organizations were used. Since the adjustments made with a sound track from one organization did not always meet with the approval of others, they in turn modified their characteristic to obtain maximum results from this theatre adjustment, which as a consequence, was ever changing.

"This practice created a vicious cycle of theatre adjustment and studio compensation adjustment. The studio sound recording departments, in an effort to maintain a desirable overall output in the theatres, have departed from linearity by reducing the modulation at low-frequencies to offset the rising low-frequency characteristic which has been present in most reproducing equipments. This deviation has been found in some cases *to be as great as 20 db.*

"It was finally realized by those familiar with, and responsible for, the successful projection of studio sound recording that this situation was becoming more and more impractical. It is recognized that, in order to obtain the optimum result from studio sound recording, each reproducing system should be made to possess a linear characteristic in its own right, and that the recognition and application of this policy by both branches of the industry will result in a uniform optimum reproduction of recorded sound from all companies and in all theatres."

Speedy Change Recommended

In concluding the report, the Council recommends that *all theatres equipped with two way reproducers adjust their equipment to meet the new Standard Electrical Characteristic as soon as possible,* in order to obtain optimum sound in the theatre.

The circulation by the Academy of 19,000 copies of this bulletin direct to all theatres in the United States renders unnecessary the inclusion herein of detailed specifications relative to this new standard. In most cases, if not in all, the adjustment will be made by the sound service engineer.

• • •

First Standard Releases

The following current releases are typical recordings made to fit the new Standard Electrical Characteristic for two-way reproducing systems, and should, if the theatre system has been adjusted to the new Standard, give optimum sound in the theatre:

Lost Horizon	Col.
Maytime	M-G-M
Swing High, Swing Low	Par.
Michael Strogoff	RKO
Midnight Taxi	20th-Fox
History is Made at Night	U. A.
Top of the Town	Univ.
Green Light	War.

Releases of *all companies following those listed above* will be recorded to fit the Standard Characteristic, and the adoption of the Standard will result in a more uniform sound quality from all companies in all theatres.

This Very, Very Efficient Picture Business

Lifted from *M. P. Daily* is appended item, evidently intended to be humorous:

> When is bicycling legal?
>
> Harry H. Buxbaum, sales head of the N. Y. 20th Century-Fox, has the answer.
>
> With only 50 prints of "On the Avenue" on hand and 80 bookings this week from practically every important independent circuit, Buxbaum solved the problem by giving official sanction to the circuits to switch prints around from one house to another.

Such switching would involve some perfect timing to make all the programs; but even if it isn't accurate, it's still a good story. Questions: (1) what did the prints look like when they finished these runs? and (2) what kind of inspection did they get when they were returned to the exchange, before reaching the subsequent-runs—immediately following?

• Letters to the Editor •

Service Data Scarce in Canada; Suggests Section

I am servicing RCA equipment in my theatre under particularly trying circumstances, since it is practically impossible in this part of the country to get information along certain lines. It is certainly a hard proposition to keep up with the times here, as craft service is so limited. I. P. contains a lot of data, but even it has its limitations when it comes to questions of servicing.

Would it be possible to have a page set aside for questions or for experiences gained in the servicing field by the subscribers to I. P.?

W. Hoy
Calgary, Alb., Canada

Because of current negotiations looking toward unionizing electrics' servicemen, these companies have clamped down hard on all service dope, figuring that they are not interested in helping a craft which might grab their service work. Data formerly given cheerfully to I. P. is now refused. It certainly would be possible to have a service page in I. P., if the boys would keep it going with contributions.

Cathode Ray Oscilloscope A Fine Projection Tool

The standards of acceptable sound reproduction in the theatre are constantly being raised. Engineers' and manufacturers' announcements of new technical developments and equipment are a constant reminder to the projectionist that his is the responsibility for the perfect presentation to the public of all the artistry and technical skill that have gone into the making of a production. It is to be expected that new test equipment and methods of service procedure would be a natural result of these improvements.

The latest, and perhaps the most interesting and versatile, service instrument is the cathode ray oscilloscope. While most engineers agree that its potential applications have yet to be fully realized, enough is known about it to justify its acceptance by projectionists. Tests that can be made of a sound system may be classified under the general headings of Static and Dynamic. Static tests are the conventional voltage, current and resistance tests that we are accustomed to making. In such tests we are checking fixed operating conditions, and while it is necessary to check these constants, experience has shown that this is not always sufficient. We have found that it is possible to experience operating difficulties with a system in which all static conditions are correct.

Development of the oscilloscope has opened a new field of testing procedure and has greatly simplified the method of locating the source of these difficulties that are not indicated by Static tests. The projectionist may now observe with this instrument the signal at any point in the entire system—from the output of the p.e.c. to the input of the voice coil. This observation of the signal is a Dynamic test, and in addition to indicating incorrect fixed operating conditions, it makes it possible to trace the source of hum, extraneous noise pickup, and what is perhaps most important, all forms of distortion.

Projectionists will quickly appreciate the utility of an instrument that can be used as a visual output meter at any point in the sound system. Its use during an emergency will quickly isolate a defective part or unit of the system and will leave more time for the repair or replacement of the part at fault. Experience has shown that it usually takes far more time to locate trouble than is needed to make a repair. The method of proceedure at such a time will be largely governed by existing conditions and the familiarity of the projectionist with the test equipment at his disposal.

It is not to be assumed that the oscilloscope will replace conventional test equipment in the projection room. It is, however, a valuable addition to this equipment and will undoubtedly find wide acceptance where the highest quality of sound is consistently maintained. The new low-cost RCA-913 Cathode Ray Tube with its correspondingly lower priced associated equipment should do much to popularize this equipment among projectionists. This equipment will not find much acceptance and is not intended for men who do not understand the basic theory of electricity. However, those who have made the effort to study the elementary principles of their work will find much of interest and value in the Cathode Ray Oscillograph, and it will serve to clarify much of the theory that has been so difficult to visualize.

It would be impossible in such a brief discussion to mention all of the uses of which this instrument is capable. They merely represent the experiences of the author, who has used a Clough-Brengle Model CRA oscilloscope for about a year for both routine and emergency testing.

G. Carleton Hunt
Miami Beach, Florida

WIDEN I. A. THEATRE FIELD UNION DRIVE TO INCLUDE ALL UNORGANIZED WORKERS

NEW angles to the powerful I. A. organizing thrust in the motion picture industry developed during the month when it became apparent that full use would be made of I. A.'s jurisdictional claim to every classification of worker, except managers, in the business. Exchange workers are already in the I. A. bag, and their direct charters will vanish like the snow in the Spring. Next in line for organizing are theatre service workers — ushers, doormen, cashiers, cleaners, *etc.* — with no strong opposition in sight.

I. A. consolidated its exchange organizing position meanwhile. The drive that started in Boston has now spread throughout the country and likely will be completed within 60 days. Unionization has meant wage increases of from $5 to $11 for this type of labor. Typical demands are those of Boston and Cleveland exchange workers: the latter wants $24.50 for head inspectors and $22.50 for inspectors (a $7 increase) vacations with pay, a 40-hour week, time and one-half for overtime, and a closed shop. Boston shippers now receiving $27 have been offered $37.50, and a closed shop is assured.

Even exchange bookers and salesmen are interested in organizing, but the commission status of the latter makes their participation doubtful. When, as and if I. A. cleans up everything it is now grabbing for, it will be strictly a vertical union, A. F. of L. sentiment to the contrary. In the path of this I. A. cleanup are several crafts over whose jurisdictional claims I. A. appears certain to ride roughshod. The only jurisdiction I. A. is recognizing now is that of I. A., according to present tactics. When the battle is over the only union in the picture business worth thinking about apparently will be I. A., the others seemingly being destined to assume the roles of mere hangers-on. Studio Utility Employees Union, Local 724, on the Coast has already filed a complaint against I. A. with the National Labor Relations Board, charging that I. A. is "raiding" its membership.

Reported C. I. O. organizing activities in Hollywood are taken seriously by practically nobody, the futility of trying to buck I. A. being apparent. The Empire Projectionist Union of Hollywood is reported to have affiliated with the C. I. O.

A 10 per cent increase in wages for the approximately 20,000 members of four internationals — I. A., the Teamsters, the Carpenters, and I. B. E. W. — was the outcome of the recent New York conferences between Labor and the producers on the five-year Studio Basic Pact. This increase of $3,000,000 annually to studio payrolls does not apply to the Musicians, who will negotiate a separate pact. George E. Browne, I. A. head, announced that he would support the request of the Screen Actors Guild and 14 other Coast labor groups for admission to the Basic Pact, in conformance with a resolution adopted at the last A. F. of L. convention.

Exhibitor leaders, in noting Supreme Court approval of the Wagner Labor Act, expressed concern that various states might enact similar legislation and thus place the smaller theatres within reach of union organizing drives. At present these theatres do not come under the Wagner Act.

The De Luxe and the Consolidated film laboratory plants in the East have signed a closed-shop agreement with I. A. Local 669 of New York.

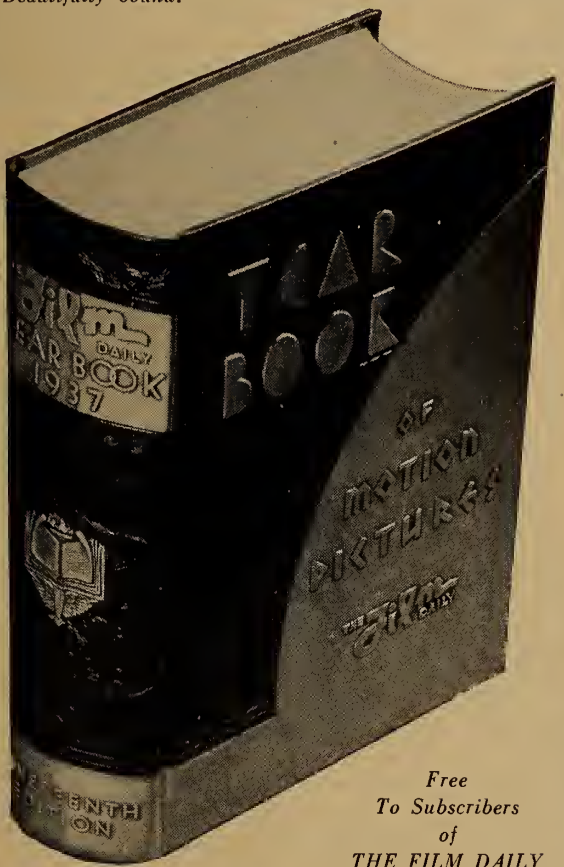
JUST OFF THE PRESS!

THE 1937 FILM DAILY YEAR BOOK

of

MOTION PICTURES

Weighs over 6 lbs.
Contains nearly 1,300 pages.
Beautifully bound.



Free
To Subscribers
of
THE FILM DAILY

★

The largest and most comprehensive volume in the long series of Film Daily Year Books is now being distributed to paid subscribers of The Film Daily. The 1937 book, 19th edition, contains nearly 1,300 pages of valuable reference material. Among the many items of interest are included: PICTURES—16,170 titles of features released since 1915 showing distributors and Film Daily review dates; Features released during 1936 with casts and credits; Features and short subject series released during 1936, arranged by distributing companies; serials released since 1920 showing stars, directors and years of release; a list of features imported from foreign countries during 1936; a compilation showing producers and distributors of short subject series. PERSONNEL—Names, addresses, telephone numbers, cable addresses, officers, department heads and boards of directors of important film companies; another section with the addresses and manpower affiliated with studios and production organizations; Officers and directors of clubs, guilds and organizations associated with the motion picture industry. PERSONALITIES—The 1935 and 1936 work of 3,124 players, 218 producers, associate producers and supervisors; 281 directors; 809 authors; 635 screenplay writers; 181 cameramen; 196 film editors; 152 music composers and supervisors; and 27 dance directors. LISTS—A complete equipment Buying Guide; feature producers, short subject producers, cartoon producers, industrial producers, newsreels, theater supply dealers, laboratories, color processes, trailers, insurance brokers, projection rooms, agents and managers, play and story brokers exchanges (including names of managers and product handled). THEATERS—Complete list of theaters in the United States and Canada arranged by states and provinces; separate list of circuits with four or more theaters. FINANCIAL—Summaries of all motion picture companies whose stocks are listed on financial markets. FOREIGN—Exporters and importers; outlook for 1937; international survey of film markets. EXPLOITATION—Complete manual of tested exploitation stunts; showman's calendar. AGENTS' TELEPHONES of players, directors and writers. LEGAL—Court decisions of 1936 compiled and digested by Herbert T. Silverberg. BIRTHDAYS AND BIRTHPLACES of important film folk, and 1,001 other items of interest.

Your Check for $10.00
Will Bring You This

COMPLETE SERVICE

THE FILM DAILY

Every day except Sunday, covering the news of the industry; reviews of features and short subjects equipment; a publication every exhibitor needs.

SHORT SUBJECT QUARTERLIES

Four times a year; an issue devoted exclusively to Short Subjects, giving reviews, programs, exploitation ideas, in fact everything about shorts.

DIRECTOR'S ANNUAL AND PRODUCTION GUIDE

Every June—A volume devoted to Production plans, activities and credits.

FILM DAILY YEAR BOOK

Filmdom's Recognized Book of Reference. Nearly thirteen hundred pages covering every branch of the industry.

THE FILM DAILY
1501 Broadway, New York City

Dear Sir:

Please enter my subscription to the FILM DAILY, and The Film Daily Service.
I enclose $10.00 (foreign $15.00).

NAME ....

STREET ....

CITY .... STATE ....

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

THE recent M. P. T. O. A. convention at Miami, three grounds of complaint against the "radio menace" to theatres were brought out as follows:

1. That free professional entertainment brought into the home by radio is direct competition with the theatre, more so when the same talent is used in both radio and screen entertainment;

2. That constant use of a screen star in radio broadcasts damages their box-office value, destroys their prestige by familiarity and by inadequate staging; and

3. That excerpts from current pictures and condensed versions of a photoplay given over the air destroys interest in the picture when it plays at the local theatre.

The M. P. T. O. A. will welcome ideas and suggestions on the radio problem, will undertake to examine the practical matter of what should be done, how it can be done and what sort of regulation or control would reduce the damage to stars and theatres to a minimum.

Dismiss Sherman Indictment

Indictment charging Harry Sherman with misappropriation of funds from Local 306, of which he is former president, has been dismissed in General Sessions Court of N. Y. City. Charges were pressed by so-called opposition faction in Union described by Sherman as having been inspired by Sam Kaplan, his predecessor as 306 head.

Metro's Television Release

Metro will release soon a two-reel short detailing the advances made in television to date, marking the first official attention paid this baby art by picture industry. Short will be accorded "impartial treatment" by Metro, and while attention will be given obstacles ahead of commercial television, no attempt will be made to belittle or begrudge accomplishment in art so far.

Emile Pathe, Pioneer Film Worker, Dies in Paris

Emile Pathe, pioneer motion picture worker, died in Paris, France, on April 6. Pathe and his brother, Charles, started French production in 1896 when they organized Pathe Freres and issued films with the well-known crowing rooster trade mark. An American branch was established in 1904. Four years later the company, with Emile and Charles in control, opened a studio in Jersey City. In 1914 the company produced "The Perils of Pauline," with Pearl White in the leading role. Five years previous the company had shown the first news film.

The brothers started with two Kinetoscopes, an Edison invention. Their venture grew to proportions that included completely equipped coast studios and an imposing list of star names. In the latter part of 1930 they disposed of their American company and properties to a group of New York bankers. The present company here is now engaged in the printing and developing of negatives, the producing and distributing business having been sold to RKO.

Television 'School' Kayoed

Mail-order school holding forth hopes of highly-paid jobs in television has run afoul of the Federal Trade Commission. Declaring representations are exaggerated, misleading and untrue, Commish issued complaint charging unfair competition against American Television Institute, Inc. of Chicago. Firm which advertises that big openings are available in picture broadcasting, claims to own a huge laboratory and operate several television stations, also promises to place postage-stamp graduates in handsome spots in the industry.

Commish says it's all imaginary, except that promoters are engineers for certain unidentified broadcasting stations in the West.

Eastman Hikes Wages 20%

A wage increase approximating 20 per cent has been granted by Eastman Kodak Co. coincidentally with the payment of $2,122,555 to employees through the company's 25th annual wage dividend. The increase in wages, effective in the Rochester plant, will increase the payroll by an amount estimated to exceed $1,500,000. The purpose of the wage increase, says the company, is to raise weekly earnings on the average to approximately those prevailing under the 48-hour week formerly worked. The factories are now on a 40-hour schedule. The number of employees eligible for the wage dividend is 23,987.

Blank & Stoller

Whitford Drake, new president of Erpi, with which company he has been associated since its formation in 1927

H. M. Warner on Television

Harry M. Warner, head of Warner Brothers, on his return from a recent European trip, said that the motion picture industry will control television when it is a "commercial reality". He didn't say how this was to be accomplished. He did say, however, that the much-advertised English television was no better than he had seen in America.

Acquisition of control of Transamerican Broadcasting and Television Co., newly formed corporation, by Warner Bros., which has 65 per cent voting stock interest, was made known through a report filed with the Securities and Exchange Commission. According to the report, the new firm will engage primarily in the business of representing radio broadcasting stations as advertising agents and in preparing programs for advertising agents, placing them with broadcasting stations. The company is expected to eventually operate radio stations.

Conn. 2-Men Bill Killed

Two-men shift bills have again been killed in the Connecticut State Legislature. Judiciary Committee reported the bills unfavorably after a second hearing, and the lower house accepted the report. Exhibitors cited the new 2000-foot reel standard in opposition to bills—in case those projectionists who yelled long and loudly for such reels are interested.

Resume RCA Television Tests

Field tests of RCA experimental television with the new 441-line definition have been resumed from Empire State Building, in N. Y. C., by the National Broadcasting Company on the largest scale ever undertaken in the United States. The tests will continue throughout the spring and summer months.

Film Exec., Star Salaries

Louis B. Mayer, Irving Thalberg, deceased, and J. Robert Rubin as co-partners in Louis B. Mayer Pictures, split a $1,220,242 bonus of Loew's Inc., during the corporate fiscal year ending in 1936, according to a S.E.C. report made public recently.

Other film salaries disclosed included:

Nicholas M. Schenck, Loew's president, $312,785; Kay Francis, $227,500; David Bernstein, Loew's vice-president, $213, 857; Arthur M. Loew, $205,544; Joe E. Brown, $201,562; Leslie Howard, $185,000; and three from Universal Pictures—Irene Dunne, $102,777; James Whale, $105,000; and Gregory Lacava, $102,500.

Columbia Pictures reported these salaries: Harry Cohn, director-president, $182,040, including expense allowances; Frank Capra, director, $208,000; Ronald Colman, actor, $162,500.

N. J. Theatre Divorce Bill

Latest legislature to receive a theatre divorcement bill is New Jersey, where a measure has been introduced in the Assembly. Similar bills, requiring producers to drop their exhibition interests, are pending in a number of statcs elsewhere in the country and North Dakota has a new statute to this effect, constitutionality of which will be tested by Par.

Film Explosion Death Toll

The explosion of a film during a showing at a school in Killingi, Estonia, where 100 children had assembled, caused five deaths on April 20. The projector was placed in a doorway, so many children rushed into the fire. Others leaped through windows into the street.

Seventy children were taken to hospitals. Fifty were badly injured. The condition of ten is critical.

Woman Heads Exchange Union

The A. F. of L. exchange workers union in New Haven, Conn., has elected as president Katherine B. Fitzgerald, first woman so designated. Unit was organized with I. A. assistance.

Standard Framing Project by Academy Committee

The Academy of M. P. Arts & Sciences has announced the appointment of a Committee to set up standard methods for framing in photography and projection under the Chairmanship of Grover Laube and consisting of John Aalberg, Sydney Burton, Frank Cahill, Wallace Castle, Merle Chamberlain, Byron Haskin, Ray June, Arthur Miller, Virgil Miller, Thomas Moulton, Emil Oster, Harry Rubin, William Rudolph, Homer G. Tasker and Gordon S. Mitchell, manager of the Research Council. This project will help to improve the quality of pictures in the theatre by eliminating the possibilities for cutting off heads and feet on the screen.

Value of Research Bureau Cited by I. B. E. W.

Appended is an excerpt from official release by I. B. E. W. relating to worth of Research Bureau established by International Office. I. P. has long advocated setting up of similar bureau by projectionist groups. Statement, which is self-explanatory, follows:

1. This information places the I. O.

in most favorable position of any international office of any labor union.

2. Enables I. O. to prepare briefs to appear in cases before private employers and government departments.

3. Enables I. O. to know instantly wages, hours, working conditions, and employment status of members.

4. Enables I. O. to watch trend of electrical work from one field to another.

5. Makes permanent economic record over many years for the entire union.

(But before these great gains can be made, records must be kept; this depends on the faithfulness of union officials and the cooperation of individual members.)

How Local Unions Profit

1. The research record places important matters of hours and wages on an orderly bookkeeping basis, as are financial accounts.

2. Enables union to affirm or deny statements of contractors and other employers in wage negotiations.

3. Acts as corrective on employer's figures in estimating jobs.

4. Serves as basis for just distribution of jobs among members during scarcity of work.

5. Enables unions to negotiate wage increases on intelligent basis.

6. Enables unions to keep pay roll records for social security purposes.

7. Enables unions to know instantly trend of work in each classification.

SUPPLY FIELD NOTES

Plans for an "equipment exposition" to be held in connection with future M.P.T.O.A. conventions are already in work. The proposal, first broached at the exhibitor organization's recent Miami convention, was receiving strong support

from equipment manufacturers and supply dealers and interest in it at this point is sufficient to warrant continued planning. The equipment exposition would be held during several days either preceding or immediately following the annual convention to avoid conflicting with convention programs.

NEW JENSEN 18" SPEAKER

The new Jensen 18" mogul speaker, manufactured by the Jensen Radio Manufacturing Co., Chicago, is finding favor in the field. The new speaker has a newly designed voice coil centering device and dirt proof protection. Frequency response, different models, from 40 to 10,000 cycles. The power-handing capacity is 30-watts continuous. Voice coil impedance 8 ohms at 400 cycles. It is built with a heavy-duty 5Z3 rectifier and tube.

NATIONAL CARBON SAN FRAN. NEW OFFICE QUARTERS

The San Francisco district office of the Carbon Sales Division of National Carbon Co., formerly located at 599 Eighth St., has moved into newly established quarters in Room 524 Adam Grant Building, 114 Sansome Street.

The following products manufactured by National Carbon are handled by this division of the company: carbon brushes, welding carbon products, chemical carbon products, carbon and graphite specialties, graphite powders, lighting carbons, carbon arc lamps.

This office is under the direction of E. C. Friday, district manager.

PUSH-PULL RECORDING AND REPRODUCING SYSTEMS

(*Continued from page* 20)

separate tracks, more space separates the changes in exposure. This permits sharper definition of the tracks. There are certain forms of inherent distortion that are entirely eliminated with this type of recording, due to the fact that the tracks are mixed 180 degrees out of phase with one another, thus cancelling out the distortion.

Other Push-Pull Tracks

Recently, other types of push-pull sound tracks have been found to be practical. These do not involve the separation of halves of each wave into two tracks, but in one case involve the recording of the high frequencies on one track which is somewhat narrower than the other one on which all of the low frequencies are recorded. This permits the lower frequencies to be better recorded and reproduced with relation to the high frequencies. In this case the tracks are mixed in phase with one another. It is conceivable that several types of double-track recording could be made as long as both tracks do not occupy more space on the film than does the present standard track.

Both the necessity for especially modified soundheads and the complication and cost of distributing two types of release prints has held back the general introduction of push-pull recording for release prints, despite the fact that push-pull recordings permit the finest quality sound yet achieved. Several of the large Hollywood producers are making all of their original negatives with push-pull, and then in the final re-recording stage, when the recordist has ample time for proper adjustments, converting it to standard track. This is decidedly a compromise, however. A few de luxe pictures have been released to two or three "two-a-day" theatres with push-pull recording, and the results have more than justified the trouble.

General Print Circulation Remote

Both RCA and ERPI can furnish soundheads with their new equipments which will reproduce push-pull recording. All new ERPI Mirrophonic installations of the heavy-duty, TA7400 soundhead are equipped for push-pull reproduction. RCA Rotary Stabilizer soundheads of the latest design are available either way. One large circuit[1] is equipping every one of its theatres throughout the country for both standard and push-pull reproduction. This circuit could arrange with its affiliated producer to

release prints with the push-pull track to its theatres, despite the added cost and complication, to take advantage of the better sound quality. This may be the wedge by which many progressive theatres will make use of such prints.

While push-pull versus standard recording is a refinement, the improvement in the reproduced sound cannot be denied, and now when we are striving for perfection more than ever, and the public is demanding it, all progressive projectionists should prepare for this new type of recording.

---

[1]Reference is to Loew's Theatres, Inc. Idea of special push-pull prints for this circuit, even with its M-G-M studio affiliations, appears impracticable, because circulation of such prints, after Loew showing, would be very narrow. Push-pull reproducing equipments may become so common within a year as to justify release of such prints. —Ed.

THE PROJECTION OF BERTHON-SIEMENS COLOR FILM

(*Continued from page* 18)

example, evening scenes appear too red compared with noon exposures. In general, the eye adapts itself to the predominating mood of the picture, so that in a change of scenery the next image at first shows a mood corresponding to the complementary color of the preceding image.

These difficulties can be avoided if, in changing an image, the mood of the following image is adapted to that of the preceding image. In an optical print from the lenticular film, the light-rays belonging to the red, green, and blue component images can be controlled separately. By introduction of diaphragms in the printing optics, the mood of a picture can be changed at will.

In practice color control is effected in the following manner: At first, an uncontrolled copy is made, which is projected through an objective having controllable apertures in the red, green, and blue zones. In order to facilitate fine color tone changes, a controller is used which influences the objective diaphragms by movement of a single control member in the control triangle which is coupled to the diaphragm. The transmission of the movements of the control member on the filter zone diaphragms takes place electrically.

The connection of the open filter areas to the positions of the control member in the control triangle is so arranged that changes of the white point of the projection correspond to the movement of the control member in the control triangle. If the control member is adjusted for the white point of the control triangle, the projected image reproduces a mood as it actually was at the time of the exposure. If one describes a circle about the white point with the control

member, the color tone runs through the entire color circle around the white.

Uniform Release Prints Assured

A trained judge of color quality decides the necessary correction for the individual images with the aid of the control triangle. In order to judge the effect of the correction of the individual scenes during the run of a film, a perforated strip is made which automatically controls the diaphragms of the projector objective (on a contact aparatus). The start of the adjustments of the diaphragms is effected by a film contact. After the necessary fine adjustments, further prints are made by control of the printer diaphragms by means of this controlling strip. The theatre prints are then uniform in the color tone assigned to them by the color-quality judge on the control projector, without the use of any control arrangement upon the theatre projectors.

NEW FIELDS FOR PROJECTION EQUIPMENT, EMPLOYMENT

(*Continued from page* 17)

to the projectionists' union. A modern sound outfit is a pretty heavy investment, and the interest thereon is a big factor. As the theatre must be idle a large part of the time, rental charges, if the objective is to realize a profit must be adequate to cover. Prices range as low as $1 a reel projected to $25 per show regardless of length.

Undoubtedly, buildings where picture

projection facilities are available would find it profitable to employ a live wire salesman to exploit the theatre and to spend his labors selling its time. He would find it profitable to use direct mail, circularizing local commercial picture producers, exchanges, large corporations, advertising agencies, tenants and associations. In addition, solicitation of the groups of prospects listed above in person would probably produce a surprisingly large volume of business once the facilities became widely known.

Without such effort it is doubtful whether many buildings—even the biggest—could depend on sufficient revenue just drifting in. The use of sound pictures is becoming more general in business every year. It is manifest that with a restoration of normal times, pictures will be used even more widely.

The cost of renting a regular theatre for a business picture show is nearly always prohibitive. Hence, with the wider use of the screen the demand for office building projection rooms will certainly force owners of all new, large structures to fall in line and get ready.

Most of the leading hotels in the larger cities have found it advisable to purchase or rent sound picture projection outfits which are utilized in ball rooms for conventions or entertainments. But the ordinances and codes governing the use of hotel electrical facilities have nullified to a great extent the full advantages of having such a service available.

It also is true (and I speak from personal experience) that the quality of projection ordinarily rendered by the hotels is inferior. The office building auditorium, with a permanent picture projection installation can insure a much better show.

Large Units Unnecessary

After all, sound projection is being greatly simplified each year, and outfits suitable for office building use are being made to sell at a lower cost. As audiences commonly found in office building projection rooms are seldom large—from 20 to 300 persons—the largest units made for theatrical use are not needed.

Experiments with skyscraper projection facilities give little by which to judge the wisdom of including them in plans. The fact remains that pictures are going to be used increasingly for a wide variety of purposes in propaganda and in business, and the structure with an adequate setup will have much in its favor.

Ed's. Note: The foregoing contribution, while interesting, does not take into account other aspects of the constantly-widening field for projectionist equipment, which means new opportunities for projectionist employment.

Motion picture shows aboard ships is an old story, of course; but even now several of the larger railroads are seriously considering offering picture shows on their long-run trains.

School Field Tremendous

The field of industrial motion pictures, too, is but in its infancy; while the possibilities of motion pictures in education are unbounded. For example, it is not generally known that the Motion Picture Bureau of the Y.M.C.A. is the largest single distributor of non-theatrical films in the world. In the first three months of 1937 it distributed more than 23,000 films.

Twenty state universities now have extension divisions which dabble in the

distribution of motion picture films touching on almost every conceivable topic. Several correspondence schools are now experimenting with courses supplemented by films. Every first-class school in New York City is now equipped with motion picture projection equipment, many of the auditoria seating 1000. Orders for projection equipment in 199 schools were placed recently. It is estimated that there are now more than 25,000 clubs in the United States having complete sound projection installations.

The Y.M.C.A. now ships weekly by Railway Express about 12,000 pounds of education films to churches, clubs, schools and other community groups. This organization estimates that there are now between 70,000 and 80,000 non-theatrical projection machines in the United States. Many of these accounts book their films over a year in advance.

It is obvious, therefore, that the professional field is relatively small potatoes when contrasted with other fields in which the opportunity for use of projection equipment and for vastly increased employment of skilled projectionists is unlimited.]

MODERN AMPLIFIER DESIGN REFLECTS RAPID PROGRESS

(*Continued from page* 11)

rectifier tube, a resistance is wired in series with the negative d.c. pole.

Assume this resistance to be shorted out, completely removed from the circuit, and assume further that each of the grids is wired to the negative end of its respective cathode resistor, as just described, and Fig. 3 is a conventional circuit in the matter of grid bias, being of the "self-bias" type. This circuit has one disadvantage. The bias of each tube depends upon the voltage-drop in the cathode resistor, and therefore upon the plate current. As the plate current through the tube changes, the grid bias fluctuates. At very high volume, especially in Class B amplifiers, the effect is to unstabilize the action of the tube, introducing distortion which in some cases may become extreme and compel reduction in the volume.

Now, returning to Fig. 3, consider the resistor in series with the negative return to be connected and operating as there shown; consider that the two cathode dropping resistors have been shorted out and eliminated; and that the grids have been returned, through grid resistors of suitable value, to the negative or right-hand end of the common resistance. That resistance then takes the place of the two cathode dropping resistors. By virtue of the voltage-drop through it, each grid will be negative with reference to its respective cathode. But this negative bias now depends upon the plate current of *both* tubes.

Assume further that the right-hand tube of Fig. 3 represents a push-pull stage, in which plate current in one tube increases while that in the other tube of the pair decreases. Then the greater part of the current through the series resistor will be relatively stabilized, and the small variations of the plate current of the left-hand tube will effect only a very minor change in the total voltage-drop. Grid bias of all tubes will remain comparatively independent of changes in volume. The arrangement is called "semi-fixed bias". It represents a compromise approach to the "fixed-bias" in which grid voltage is obtained from batteries, bias cells (which are special small batteries) or from a separate grid supply rectifier.

If the two tubes of Fig. 3 need different values of grid bias, the series resistor is equipped with taps at the proper points, and the grid of each tube is connected, through its grid resistor, to that point which provides the appropriate voltage. All cathodes still return to the left-hand or positive end, as shown, and the right-hand or negative end goes to the negative terminal of the rectifier.

An interesting variation is that of *grounding* the left-hand end of this resistor, and grounding each of the cathodes separately. This method reduces wiring. When it is encountered, ground and negative cannot be considered the same thing; ground will be positive by the extent of the voltage-drop in the resistor, and the negative terminal of the plate supply must be kept carefully insulated from the chassis.

Simplex PROJECTORS — DISTRIBUTED BY NATIONAL THEATRE SUPPLY COMPANY

TRADE MARK REG'D

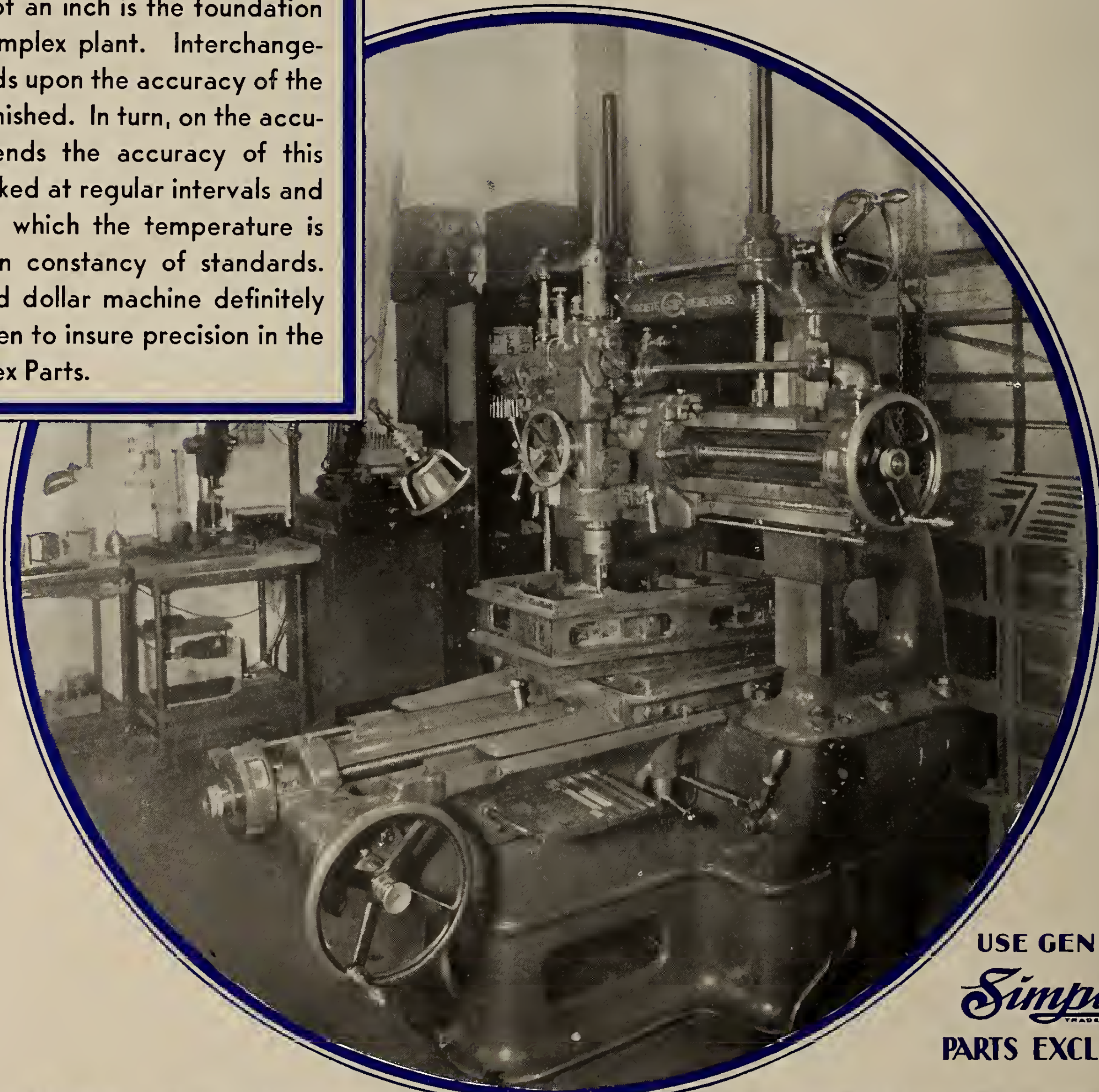
THE FOUNDATION of ACCURACY in the Simplex PLANT

TRADE MARK REG'D

Where Interchangeability begins

This machine which operates to a tenth of one thousandth part of an inch is the foundation of accuracy in the Simplex plant. Interchangeability of parts depends upon the accuracy of the jig in which they are finished. In turn, on the accuracy of the jig depends the accuracy of this machine which is checked at regular intervals and located in a room in which the temperature is controlled to maintain constancy of standards.

This ten thousand dollar machine definitely indicates the care taken to insure precision in the manufacture of Simplex Parts.



USE GENUINE **Simplex** PARTS EXCLUSIVELY

TRADE MARK REG'D

ONE HUNDRED THOUSAND DOLLARS WORTH OF EQUIPMENT AND PRICELESS EXPERIENCE TO TEST AND CHECK Simplex PARTS

Simplex Parts are given a series of exact tests to insure precision workmanship. Ninety per cent of American Theatres are equipped with our products and thousands of Simplex Projectors are used throughout the world. This tremendous business enables us to lower costs and maintain Simplex Superiority by the use of the most modern manufacturing aids such as shown in this advertisement.

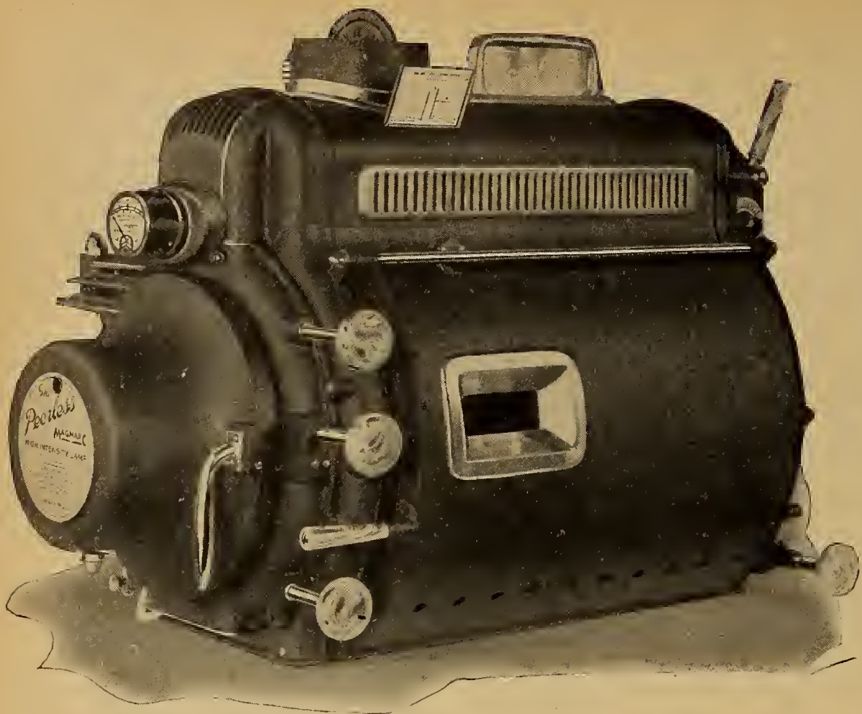
INTERNATIONAL PROJECTOR CORPORATION

International PROJECTIONIST

MAY 1937 Vol. 12, No. 5

25c Copy

$2 a year



International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 12 MAY 1937 *Number 5*

Published Monthly by

JAMES J. FINN PUBLISHING CORPORATION

580 FIFTH AVENUE, NEW YORK, N. Y.

Circulation Manager, Ruth Entracht

Subscription Representatives

Australia: McGills, 183 Elizabeth St., Melbourne

New Zealand: Te Aro Book Depot, Ltd., 64 Courtenay Place Wellington

England and Dominions: Wm. Dawson & Sons, Ltd., Pilgrim St., London, E. C. 4.

Yearly Subscription: United States and possessions, $2 (two years, $3); Canada and foreign countries, $2.50. Single copies, 25 cents. Changes of address should be submitted two weeks in advance of publication date to insure receipt of current issue. Entered as second-class matter February 8, 1932, at the Post Office at New York, N. Y. under the act of March 3, 1879.

MONTHLY CHAT

THAT automatic change-over is back again, we note from the S.M.P.E. proceedings. Not that such a unit is impossible. Not at all. But all such units to date have been very impracticable, because they were too expensive, or too cumbersome or interfered with associated equipment.

Invariably the inventors of automatic change-overs think in terms of a steam-shovel to relieve mankind of the arduous duty of stepping on a foot-switch.

NOW that all U. S. exchanges are being organized by the I. A., whom will the projectionists blame for mutilated film? Probably not their brother unionists. Why not blame the equipment?

We ourselves confess to being at a loss as to whom to indict in some future editorial on film mutilation. Any suggestions?

SIXTEEN mm. boys are no longer content to speak of short throws and small screens in connection with their equipment. Now they're shooting for much larger stuff and, overall, doing not so badly. We face with fortitude the dreadful prospect of tucking the projector away each night in a nice, cozy little carrying case.

COLORISTS were very, very peeved at I. P. for taking such nasty editorial cuts at existing inadequacies of projection equipment for color-film work. They intimate—nay, charge—that we are bearing down hard upon, instead of giving a lift to, a baby art. This charge still doesn't effect a miraculous improvement in current projector, optical, carbon and screen engineering.

More than 50% of American theatres are unfit for proper black-and-white picture projection. Let the color enthusiasts start from there and do a little pondering.

SOUND equipment companies have been showing for, lo, these many months cute frequency response curves of reproducers with a black line running pretty flat from 30 to 9000 cycles, and so on. We could never reconcile these graphs with actual theatre performances, and particularly with the policy of large theatre circuits in cutting off at, say, 5600 cycles. So we pried a bit. Now we're prying some more, and soon we may have a most interesting story. Before Labor Day—we hope.

WE-WILL appreciate greatly a few hundred suggestions from readers as to the type of articles they would like to see in I. P. Sometimes our contents are a bit anemic, for which failing suggestions from the field are a sure cure.

Not that we're trying to insure ourselves an easy summer—much!

INTERNATIONAL PROJECTIONIST

VOLUME XII NUMBER 5

MAY 1937

FILM SCRATCHES: SOME CAUSES AND MEANS FOR THEIR ELIMINATION

By *A. C. SCHROEDER*

MEMBER, PROJECTIONIST UNION 150, LOS ANGELES, CALIFORNIA

SCRATCHED film! Is there a projectionist who has not had to contend with it? We know that there is a reason for everything, but scratches sometimes defy all efforts to explain why or how.

In the final analysis, a scratch is caused by a hard or gritty substance which contacts the film, and has moved over the surface, usually lengthwise. This is easily understood; but it is rather puzzling when a film is scratched by sliding over a perfectly smooth and polished piece of metal. Possibly it is caused by dust or dirt caught between the film and the metal, and it is the dirt that does the damage.

This condition is disclosed by close examination of the suspected metal object, as a shiny spot will be present which has been caused by the film rubbing against it. Such a spot is sometimes present on the Simplex aperture plate, or the film trap, especially in the older heads in which the aperture hole came closer to the film than it does in the present mechanisms.

It has been my experience that nothing can be allowed to touch the emulsion side of the film if scratching is to be avoided, which brings up the problem of the rollers in the magazines. These rollers are supposed to very nearly touch the film, so that no fire will pass them. But if they are too close, the film will occasionally touch the metal, and if it does, it will surely result in scratches, since the part of the roller that causes the trouble is of slightly smaller diameter than the ends of the rollers that contact the edges of the film.

Sliding Film Motion Harmful

This difference in diameter means that the peripheral speed of the two parts is different, so that the speed of the ends of the rollers is nearly that of the film traveling over it; but the speed of the smaller diameter is quite a bit less, and there will be a sliding motion of the film over the small diameter of the roller for the instant that the two are in contact at this point.

The condition is aggravated by buckled film, which is longer in the center than it is along the sprocket holes, or at the edges. For this condition to exist, the added length of film has to go somewhere, so it forms a hump, while the edges may be lying perfectly flat. This can be seen if a buckled film is placed flat on the bench: the center portion humps up every so often.

When such a film is bent in a curve, as it is when entering or leaving the magazine fire valves, the center portion travels in a circle a little larger in diameter than do the edges of the film, which are in contact with the roller. If another roller happens to be opposite the first roller, and in a position where the film is bulging out, the bulge will touch the small diameter of the second roller and scratches will eventually result. The remedy is to have the small diameter turned down even more, after which it should be highly polished.

One might ask, why not make the roller of the same diameter clear across? One objection to this is that the roller never travels at the same speed as is the film rolling over it. There is always some slippage, and the trouble would persist. Possibly two rollers could be forced together by spring pressure, both rollers being the same diameter clear across, and the film then run between

the two. This would apparently overcome the problem of slippage, although I can't say whether this would work with film in perfect condition.

However, if the film had even the slightest tendency toward buckling—that is, the central part had not shrunk quite as much as the portion near the edges—there would be a difference in the length of the central and the outer portions, slippage would have to occur somewhere, and we would be right back where we started. I doubt that any film is perfectly flat when we get it; and it requires only a slight abrasion to leave a mark on the film. Thus, this method will have to remain an idle dream.

Relative to the magazine rollers, we must watch them closely to see that no dirt lodges anywhere around them. The throat through which the film passes seems to form a natural dirt trap. It packs in there nicer than it could be done intentionally, and in a surprisingly short time.

There are some very obvious causes of scratches, such as a reel with too much film wound on it, in which event the film comes off the reel at such an angle that its scrapes across the edge of the magazine before it enters the rollers. After some of the film has been run off, it comes down at a slightly different angle, and there is then enough clearance between it and the corner of the magazine adjacent to the rollers so that the film does not touch.

When the tension on the upper reel spindle is too light and a wobbly reel is used, the reel often runs unsteadily, that is, it runs ahead a bit and then slows down somewhat. The next instant the slack in the film is taken up and the reel is snapped again so it runs ahead. Each time that it runs ahead, when the reel is nearly full, the film may have enough slack to allow it to drag against the magazine, and thus cause fine scratches. Fortunately, the reel does not act in this manner very often when it is full, and after some film has been run off there will not be enough slack to let it scrape on the magazine. Of course, the tension on the spindle should be adjusted properly and wobbly reels should not be used, but these things do happen occasionally, and must be watched.

When the upper loop on the Simplex is too large, it is liable to flop against the casting at the top of the film trap and scratch. One projectionist I know has put an idler roller in this casting, arranged so that the film strikes this roller instead of the casting. Only the edges of the film touch the roller, so no scratches are produced in the picture or sound track.

Film strippers are capable of damaging film when not properly adjusted. There is not so much danger from this source, as it would be very thoughtless, indeed, to leave a stripper in such a position. The thing to watch is that the screws holding the stripper do not work loose and allow the stripper to fall or to vibrate into a position where it will scratch the film. Then, too, the stripper should not rub against the sprocket. If a film of oil is present between the contacting metals no particular harm will be done. Needless to say, oil should *not* be present, and when the metal surfaces are dry they may wear off in the form of a fine metallic powder or dust, some of which will get on the film. If this happens, it will eventually produce scratches—fine ones, of course, but even these should be eliminated if possible.

Small, invisible scratches may be present when the film is received. Apparently the film is in perfect condition. Subsequently scratches appear on the screen, indicating that the film is being damaged; whereas the damage had already been done, and the scratches are only filling up with dirt, making them visible. This condition may prevail in cases where the cause cannot be found, because it occurred previously, in another theatre or in the exchange.

Inspection for Prior Damage

When scratches appear the first time film is projected, many projectionists wonder if they are doing the damage or if it was on the film when received. This can usually be discovered while the machine is running by observing the film in the upper magazine as it leaves the reel or just before it enters the valve. Look at both sides of the film, using a flashlight to illuminate it if necessary. The film may be twisted slightly with the fingers, in order that the surface may be seen to the best advantage. Almost any scratch which is already present may be seen in this manner, unless it is extremely fine.

We know that the film cannot become scratched from the time it leaves the reel till it reaches the rollers in the upper magazine, because there has been nothing in contact with either side, and if scratches are seen here it is conclusive proof that the film was received in this condition.

A method whereby scratching can be localized to a certain extent is to try to arrange the show so that there will be an even number of reels. In this way the same reels will always be run on the same machine; then, if any scratching occurs, one knows immediately which machine is guilty. With an odd number of reels it is necessary to check both machines.

Another cause of scratches is violent rewinding of the film in such a manner that the various layers slip on each other, a procedure termed "stripping down." This is very bad practice and should not be done. Scratches produced in this manner probably will not appear immediately but will show when they become filled with dirt.

Still another trouble is dirt on the room floor. The ends are on the floor during the threading operation, and if any dirt is present some of it will adhere to the film. Bits of this dirt may be carried deeper into the reel after successive showings. Result: more scratches.

[One cause of film scratching not stressed in the foregoing article is the practice of some projectionists, particularly those who utilize special effects, such as Magnascope, of filing their own apertures. Ragged edges, the result of uneven filing, often occasion scratches in de luxe theatres employing special effects, notably at the Music Hall in N. Y. City. —Ed.]

New Mass. Regulations Provide for Model Craft Working Conditions

TWO-MEN projection shifts, the rock upon which many projectionists legislative ships have been wrecked, is only one of the many provisions favorable to the craft included in the new regulations governing motion picture reproduction in theatres and elsewhere promulgated recently by the Massachusetts Dept. of Public Safety. Space limitations forbid publication herein of more than the highlights of these regulations, the demand for copies of which from all over the United States being clearly indicative of its model status.

Adequate ventilation, toilet facilities connecting with the projection room proper, the right of the projectionist to reject film which in his opinion is not suitable for running, the requirement that projectors be maintained in good mechanical condition—all these requisites combine to make the Massachusetts rules a landmark in craft working conditions.

As far as I. P. knows, this marks the first time that any check whatsoever has been imposed upon exchanges with respect to damaged prints, and the projectionist is specifically designated as the sole judge thereof. While it is expected that projectionists will not abuse their authority in this direction, it is apparent that there no longer exists any alibi of poor prints to excuse a poorly projected show. The inclusion of a similar rule in codes of other states

would speedily effect widespread improvement in the quality of release prints, irrespective of run.

2-Men Language Specific

The regulations treat with the two-men shift in no pussyfooting language. Following the conventional pattern of requiring that "the operator shall devote his entire time and attention" to projecting a picture is a specific injunction against "pickups" (change-overs) when only one licensed projectionist is employed in a room. A more positive declaration on this extremely important topic could hardly have been forthcoming.

The provision for toilet facilities connecting directly with the projection room (recently voted down in the Nebraska and other state legislatures) is a most important advance in improved working conditions for the craft. Even in those states which boast of fine craft working conditions such a provision is notably lacking.

Of the utmost importance is the requirement that all rooms of new construction shall be built "strictly in accordance" with the regulations. Further, all existing rooms shall be altered so as to conform as nearly as is reasonably possible to the new rules. Obviously, exhibitors will not be permitted to delay work of this character unless the expense is deemed unreasonably heavy.

Excepting two-men shifts, ventilation and adequate toilet facilities have been the chief drawbacks to improved working conditions for the craft. A majority of legislative efforts and wage-scale negotiations have been directed almost solely to considerations of manpower and wages to the almost total exclusion of other craft needs. The new Mass. regulations are sufficient indication that this condition need not endure.

The regulations provide for a room of not less than 12′ long, 10′ deep and 8′ 6″ in height, which dimensions might have been extended with benefit to all concerned; but whatever deficiencies one might see in this section is obviously adequately compensated for by the requirements respecting ventilation. Even portable booths require ample ventilation under these rules.

It is a matter of extreme regret on the part of I. P. that these regulations cannot be published in full. However, those who are particularly interested in the topic undoubtedly can obtain a copy of this code. entitled "Laws, Rules and Regulations Governing the Use of Cinematographic and Similar Apparatus for the Exhibition of Motion Pictures (Form C)".

It will suffice to say that these regulations reflect great credit upon those sections of the craft which so vigorously

(*Continued on page* 33)

COLOR, SOUND FILM PROBLEMS FEATURE S. M. P. E. MEETING

PRODUCTION problems were accorded the major share of attention at the Spring Meeting of the Society of Motion Picture Engineers, which was only natural considering the locale of the convention at the Roosevelt Hotel, in Hollywood (May 24-28). Reproduction problems were not ignored, however, because the papers program and equipment exhibit embraced practically every phase of the motion picture industry.

Research and development of equipment and technique show greater acceleration in the last year than at any time since the first several years after sound pictures made their bow.

Outstanding sessions during the convention were those on Monday, Tuesday and Thursday evenings when the members of the Society met with West Coast technical experts. On Monday evening there was a three-hour session at Universal Studios, where talks and demonstrations were given by a number of the department heads affording members an opportunity to see a set and learn at first-hand from experts the methods of lighting and direction.

Tuesday evening members met at the M-G-M studios to see a special program of selected films dealing with sound quality, color, special effects, and unusual photography. The material demonstrated was assembled by technicians from the various West Coast studios and represented the finest examples of motion picture art.

The Academy of Arts and Sciences was host to the Society on Thursday evening where a general paper on the technical program of the Research Council was given by William Koenig, Chairman of the Council. Reports were also presented by chairmen of several of the Academy committees.

Television, Lighting and Color

Friday evening's program was of particular interest as it was devoted to the subject of television with a general paper and illustrations by Ralph R. Beal, RCA Research Supervisor. "RCA Developments in Television," is the subject of this paper. Among the many important papers read during the course of the convention, that delivered by G. Gaudio, Academy cinematographic award recipient last year, was outstanding. Mr. Gaudio's paper is "A New Viewpoint on the Lighting of Motion Pictures."

Agfa-Ansco had a paper "The New Agfacolor Process" which describes for the first time in this country this remarkable process. H. Joachim reviewed "Twenty Years Development in High Frequency Cameras," a paper on research in Germany in the field of high-speed motion picture cameras. Of particular interest to sound engineers was a symposium on transmission meters in which four or five instruments developed in the last year were described. W. J. Albersheim of Erpi delivered a paper "A Device for Direct Reproduction from Variable Density Sound Negatives" which was of particular interest to sound engineers.

The great strides forward in the educational film field, and the accompanying growing importance of 16 mm. projection equipment, were attested to by several authoritative papers on these topics. The Projection Practice Committee reported definite progress in the standardization of projection rooms and an effective means for measuring screen brightness, and also discussed motor-starting time, Suprex lamp magnification ratio, take-ups and sound screens. Most of these projects will have been completed by the end of this year.

The papers sessions were arranged according to subject matter and sessions devoted to the following subjects were held: studio problems, color, instruments, acoustic and sound, laboratory and projection, apparatus symposium, sound equipment, and television.

Some of the papers included in the program will be published in I. P. from time to time, as well as excerpts from other papers that bear on the projection process. Appended hereto are abstracts of those papers which are of particular interest to projectionists:

PROGRESS COMMITTEE REPORT

J. G. Frayne, *Chairman*

Further renovation of obsolete sound and picture equipment and continued expansion of studio floor space and facilities were noted during the past year. Another stimulant to the aroused interest in color processes was given by the announcement of a new three-color subtractive process. A multi-layer emulsion contains components in the three separate layers which react with the developing solution to produce dye images *in situ* in the layers. The completely unblimped camera has still to be adapted for modern sound pictures but a number of refinements were introduced in mechanisms and lenses. A growing tendency to use less general illumination and more effect lighting was noted.

Push-pull recording announced a year ago has made rapid inroads against previously employed systems. One type of light-valve uses four ribbons for recording all push-pull tracks. Following the lead of the Fletcher two-way horn development, systems incorporating the fundamental principles of this

(*Continued on page* 28)

A New Projection Tool:
THE CATHODE-RAY OSCILLOSCOPE

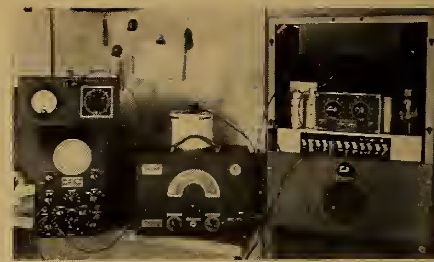


FIGURE 1

By *L. P. WORK*
MEMBER, PROJECTIONIST LOCAL UNION 601

II

IN THE first section of this article, appearing in I. P. for March last, we considered the basic theory and operation of the cathode-ray oscillograph as a general test instrument. As an introduction to the practical application of the oscillograph in testing of sound equipment we shall now consider certain simple tests.

Observation of wave-form always requires the use of the sweep on the horizontal plates, and most of the time the scope is applied that way, but there are many simple and informative tests had without the saw-tooth sweep. When a sine wave is applied to both sets of plates, either with or without their respective amplifiers, a trace similar to one of those shown in Fig. 3 is had. This pattern is known as a Lissajons' figure, of a 1 to 1 ratio, and is used in the interpretation of frequency comparisons, of phase displacement, and the like.

It can be seen that the wave applied to the horizontal plates acts in a measure as a sweep, and as such is termed a *harmonic sweep.* Obviously, no synchronization or lock-in is needed, as both vertical and horizontal waves remain synchronized by virtue of their common source. A simple and expedient means of showing presence of overload is had in the use of this harmonic sweep.

Connect the apparatus as in the schematic of Fig. 2, which shows the audio oscillator at the left, an attenuator or T. pad (the coffee can in Fig. 1) the amplifier under test, and the scope. In present-day amplifiers with gain in the order of 100 d. b. it is impractical to operate the A. F. oscillator directly into the amplifier, notwithstanding the fact that the oscillator output control is supposed to be usable from zero to 100% output. The best thing to do is to use a higher signal level, and attenuate this 30 or 40 d. b. with the resistor arrangement shown.

For precise tests the oscillator should work into a matching pad to match its impedance to the T. pad, and the T. pad into another matching pad to fit the amplifier input impedance. Such a system of padding provides change of impedance and means of known attenuation without the disturbing factors inherent in the use of transformers. They are formulae for exact determination of the values for any matching or attenuation; however, for our purpose we may select Ra to equal the oscillator output impedance, which in this case is 500 ohms. None of these value need be exact. Common ½-watt carbon resistors or any others will do.

The whole input circuit should be well shielded and grounded, using flexible shielded connecting leads and grounding all cases. The pad resistors may be mounted inside of a can of some sort, and brought out to binding posts. This input arrangement is necessary to keep inductive pick-up from stray fields at a tolerable level with the extreme input

FIGURE 3

sensitivity of modern amplifiers. Vary the output from the oscillator and note the point on the output meter straightening of the ends of the trace occurs. Later, observe if this point is reached during the regular film performance. By this method we can say with certainty whether the handling capacity of the amplifier is being taxed at any time.

The connections of Fig. 2 are for oscillator input; however, we may use the input from a sine-wave frequency film and obtain the same results. The foregoing test should be made with the amplifier volume control in full—on position, and the tone control, if any, in the setting of least attenuation which is ordinarily in the "treble" position. This input-output characteristic which is traced in the foregoing test is accurate and reliable.

Usual wave-form observations require the use of the sweep and the amplifier output across the vertical plates of the scope. Disconnect the lead from the input circuit to the free horizontal plate and use synchronization to prevent drifting of the trace. Adjust the sweep frequency to *F*/2 or *F*/3, when either two or three waves will appear, and vary the input amplitude until the cut-off point of the "least capable" stage is reached, and a flattening of the wave is had as illustrated in Fig. 4 A or B. If one side is affected, as in 4 A, some single-tube stage is distorting; while if both sides are "chopped off," as in 4 B, a push-pull stage is working beyond cut-off.

Distortion in audio amplifiers and a discussion of all the considerations in its rectification is an almost endless subject. As far as basic design is concerned, the projectionist should not attempt to alter; but insofar as distortion is a result of gradual failure and change of characteristics of component parts, he should try to isolate and analyze the cause. There are three classes: frequency distortion, amplitude distortion, and phase distortion. We shall consider the three briefly.

The first, frequency distortion, is responsible for lack of straight-line response in an amplifier. We often hear the statements "how good is it at the low end?" and "does it hold up well at the high end?" Actually, these questions refer to the ability of an amplifier to give the same voltage increase from the low end of the audio spectrum of about 100 cycles to the usable high end of 9000 cycles.

To test for flatness of response use the

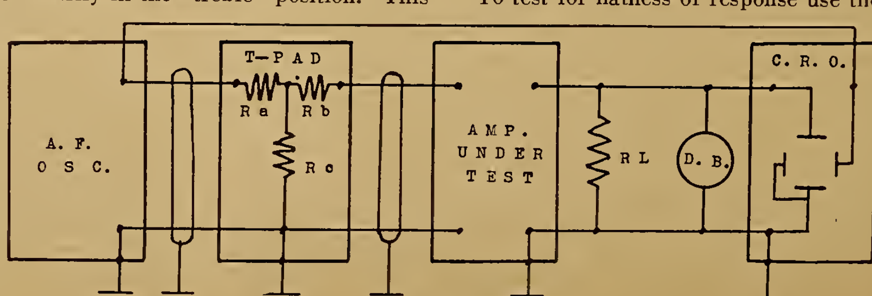
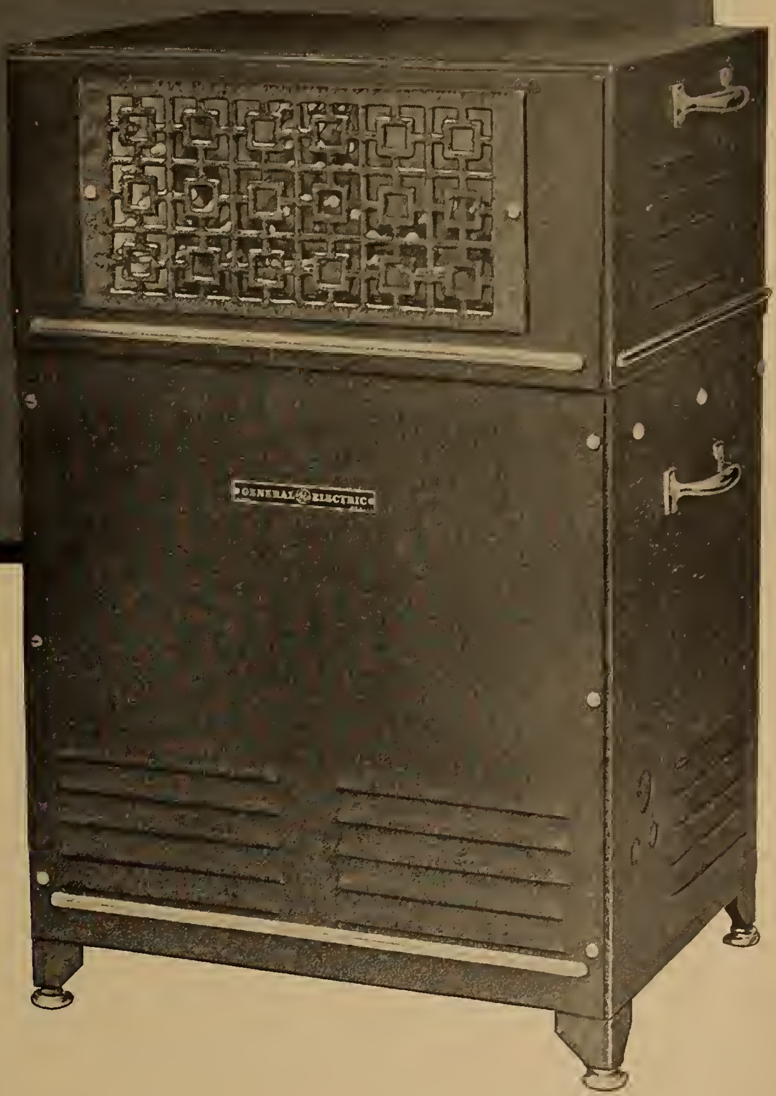


FIGURE 2

10 FEATURES

Found Only In
G-E Copper Oxide
Rectifiers



Every feature of the new G-E Copper Oxide Rectifier for Projection Service contributes to its easy installation . . . low-cost operation . . . dependability. Study the features carefully. The superiority of this G-E Copper Oxide Rectifier is unmistakable.

*1. Two-piece construction. Top section contains transformer and control panel. Base contains copper oxide elements, relays and blower. That makes for easy and speedy installation.

2. Multi-unit transformer for 3-phase, full-wave rectification, makes possible very smooth output.

3. Taps permit adjustments for any line voltage from 190 to 250 volts.

4. Secondary taps permit a wide range of adjustment in arc voltage and current to meet individual needs.

*5. New method of mounting copper oxide units. Eliminates multiplicity of wires and soldered joints.

6. Copper Oxide Rectifier unit assembly is a permanent rectifying device of proven reliability. It operates indefinitely without attention or replacement.

*7. Blower system (patented) for forced ventilation of copper oxide units. By this system, units are maintained at about room temperature.

8. Relays provide protection in event of line failure and permit operating the unit by remote control.

9. Substantial steel case with attractive crackle finish. Plain exterior, free from switches and controls.

*10. Every part of the G-E Copper Oxide Rectifier is manufactured by General Electric. Each part is properly co-ordinated with every other part. The G-E Copper Oxide Rectifier is fully guaranteed by General Electric.

*This feature is exclusive with G-E Copper Oxide Rectifiers.

For better service at lower cost, install G-E Copper Oxide Rectifiers for Motion Picture Projection. The savings effected quickly liquidate the cost of the G-E Copper Oxide Rectifier . . . and start earning extra profits. Send for full information. Write Section A-55, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

SPECIAL RECTIFIERS

APPLIANCE AND MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

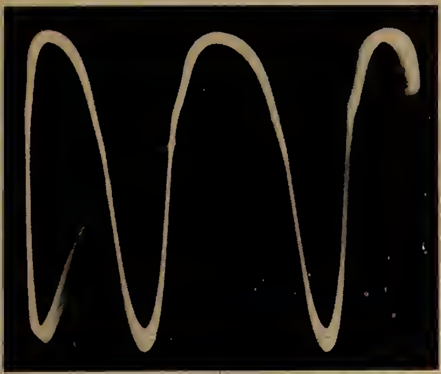


FIGURE 4-A

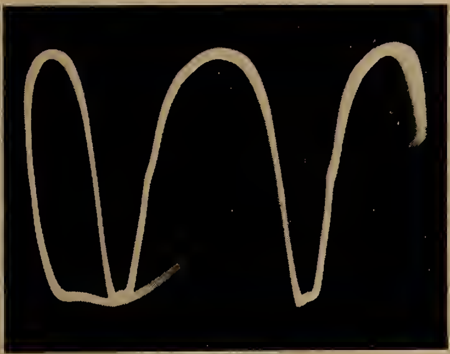


FIGURE 4-B

set-up of Fig. 2, providing a dummy load RL if the regular speaker load is not present. The meter should be a d. b. meter, but a rectifier voltmeter may be used and its readings converted to d. b. with the impedance at hand; otherwise the resultant curve will be misleading. With the oscillator output fixed, take readings at successive 100-cycle steps up the scale, broadening the intervals at the higher end. Spot these points on graph paper which has, preferably, a logarithmic horizontal scale and a linear vertical scale. Common cross-section paper may be used and the horizontal scale made logarithmic by copying the spacing from Fig. 5.

Amplitude distortion is a very common type, and refers to non-linearity between the input wave and the output wave. This non-linearity causes harmonics to be present in the output, and when severe, there will be harsh and raucous effects in the sound. Amplitude distortion may be caused by non-linear operation of tubes due to cut-off, by improper plate loading, or by effects of iron saturation, *etc.*, when impedance or transformer coupling is used.

The set-up for observing amplitude effects is similar to Fig. 2 with the exception that the free vertical plate of the C. R. O. must be switched from the output to the input at will. The sweep is used and the horizontal plate connection left free. Apply various frequencies and levels to the amplifier while switching the C. R. O. vertical plate repeatedly from output to input to compare wave-forms. With amplitude distortion the output form will not be a duplicate of the input wave and harmonic figurations will be present. Phase distortion is not of great interest to the investigator. It is not harmful to the output quality because the human ear integrates a complex wave-form the same regardless of the phase relation of its components.

There are many factors which may contribute to distortion, such as improper plate-load impedances, poor plate-supply regulation, and last but not least, some unexplainable differences in tubes which cannot be detected on an ordinary tube tester.

These tests as described are for class A amplification; to apply the illustrated curves to class B would be misleading. However, as practically all theatre amplification is simon-pure class A, we need not worry. In good amplifier design, the last stage will overload first; if preceeding stages overload before full power output is realized from the last stage, a costly reduction in available power is suffered. The tests described herein are about as good as can be done in the field without elaborate laboratory set-ups. They are only qualitative; to make any sort of quantitative measurements to ascertain percentage distortion when the amplifier is operating within its stated limits is a laboratory study requiring very complicated and costly apparatus.

The task of maintaining the sound track scanning in best possible trim at all times is one which requires constant watchfulness by the projectionist. In spite of the great range of field test equipment regularly available, there is nothing at hand to observe the mechanical quality of scanning with precision. We may adjust the exciting lamp to best field, secure the best focus with the optical system, and adjust guide rollers for best lateral position of the film for scanning and apply usual meters to check these settings—yet with all this we cannot tell by any better means than the unaided ear about constancy of the film motion.

If a good example of constant frequency film of from 1000 to 5000 cycles is available, some study of this input to the system on the oscilloscope will reveal interesting facts, chief among which is that our scanning is not nearly so good as we might think. An example of the modulation of a 5000-cycle sine wave film by sprocket holes is given in Fig. 6. Here the system output was fed to the vertical plates, while the scope sweep was set at a sub-multiple of the normal sprocket hold frequency of 96 cycles per second.

FIGURE 6

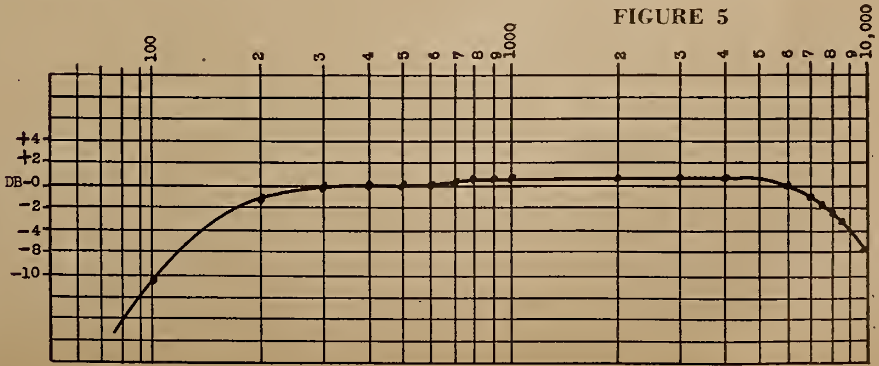
The normal unmodulated trace would give a rectangular-shaped envelope which is composed of a great many vertical traces of the 5000-cycle note. When this 5000-cycle note is varied by errors in constancy, such as sprocket holes, the resultant amplitude is altered at the frequency of this secondary influence which can be stopped on the scope by proper synchronization.

The author wishes to thank Local 332, I.A.G.S.E. for valuable assistance in the experimental work.

Triple-Damage Suit *vs.* A.T.&T. Is Dismissed in Delaware

Judge Neilds in the Federal Court for the District of Delaware has handed down his decree in the anti-trust suits brought by General Talking Pictures, and the Duovac Radio Corp. against A. T. & T., Western Electric, and Erpi. As foreshadowed in his earlier opinion, Judge Nields, the briefs on both sides, has now formally dismissed the charges as to the A. T. & T. and W. E. and denied the injunction sought against Erpi. The Court retains jurisdiction in case Erpi should hereafter endeavor to enforce the so-called "equality" and "repair and replacement" clauses.

FIGURE 5



EFFECT OF NEW RECORDINGS ON THEATRE SOUND REPRODUCTION

By *LEROY CHADBOURNE*

THE recent change in recording standards, reported herein last month, must very soon force itself upon the attention of even those projectionists who have not yet had occasion to notice it, and will compel readjustment of the operating characteristics of most theatre sound equipment.

Studios which have adopted the new standard, and the first features to be recorded in conformance therewith, were listed in I. P. last month.

Because the new standard is substantially universal, recordings of all studios will henceforth sound approximately the same in any theatre. The exceptionally good results obtained from the product of one studio, and the poor or indifferent results with prints from another source, are in the past: all future recordings will sound equally good or bad, as the case may be.

In theatres where all the new recordings reproduce very good, sound systems and acoustical conditions happen to suit the new studio standards. But in many houses the new films will sound either average or bad. Adjustment will be compulsory in the latter; and in the former, adjustments will improve the sound from good to excellent. The adjustment, once made, will be constant for all prints.

Hit-or-Miss Policy Out

This change in recording practice marks the end of the attempt by the studios to match their sound tracks to theatre conditions. That attempt, continued over a period of years, was responsible for the old chaotic conditions. Complaints originating in the field, sometimes producer-affiliated in theatres, might state that low frequencies were over-emphasized; and so on. The studio would reduce the recorded volume of such frequencies. The next complaints might indicate that the reduction had been overdone, and recording practice would change again. Meanwhile other theatres would be adjusting for these changes, and would send in their own complaints. The studios tried to please as many as possible.

The adoption of the new standard, through the Academy, became a necessity. Studios will now turn out a uniform product. Individual theatre conditions will have to be adjusted to match the sound track.

The purpose of such adjustments will be to avoid frequency distortion, which type is simple and easily understood. Suppose that in the studio there are two sounds, one of 200 cycles and one of 6,000 cycles, and that the first is ten times as loud as the second. Then in the theatre, when those two sounds are reproduced, the lower frequency should be ten times as loud as the higher. When this is not the case, there has been a failure, somewhere along the line, to treat all frequencies alike—in other words, frequency distortion.

Refer to Fig. 1. The volume or level of sound is indicated by the horizontal lines. Frequencies of sound are denoted by the vertical lines. If different frequencies of sound are supplied to any piece of apparatus at the identical input volume, and if the apparatus treats them all alike, they will all emerge at identical output volume. In that case the "curve" of the chart will be a straight horizontal line, and the apparatus will be said to have a "straight-line" or "linear" characteristic. If two sounds are supplied to straight-line apparatus, one ten times as loud as the other, they will emerge with a similar relationship.

The apparatus involved includes every item from the recording microphone to the acoustics of the theatre, and, naturally, the film itself. Not all of them are, or can be made, absolutely linear. Intensive efforts have been made to balance frequency distortion in some one item of equipment by an equal but opposite distortion existing or introduced elsewhere—this is what the studios tried to do in the past by changing their recording practices to suit theatre conditions.

TABLE A

Fig. 1, the characteristics chart, applies to the following systems:

Type I—Mirrophonic system using 594A mechanisms (loud-speaking telephones) (metal diaphragm) and TA-4181A low-frequency mechanisms (loud speaking telephones).

Type II—RCA system using MI-1435 (metal diaphragm) and MI-1432A low-frequency mechanisms.

Type III—RCA Lansing equipped system using 284 (metal diaphragm) and 15X low-frequency mechanisms.

Type IV—RCA system using MI-1428B (bakelite diaphragm) and MI-1432A low-frequency mechanisms.

Good Test Units Necessary

Now it is necessary for theatres to provide their own compensation for undesirable frequency discriminations that may exist in either their apparatus or acoustics. These corrections can be applied accurately upon the basis of proper engineering measurements, as explained subsequently. Where facilities for making those measurements do not exist, it is possible *in some cases* to use a less complete method of testing, familiar to projectionists, by taking Fig. 1 as a correction chart through which to interpret results. It is always possible to adjust by ear, but this method requires certain precautions, and can be made simpler by following a methodical procedure.

The adjustment themselves, made any of these methods of controlling the results, will vary with different types of sound systems. Some systems, explained hereinafter, may require the addition of simple and inexpensive auxiliary apparatus.

The ideal way of testing for adjustment is to use a calibrated microphone in the auditorium which will hear the sound exactly as the audience hears it, including all distortion that may be introduced by the theatre's acoustics. A number of frequencies must be played separately, picked up by the test microphone, amplified through a calibrated amplifier, and observed with a decibel meter, an oscilloscope, or a recording oscillograph.

One complication is the possibility of standing waves interfering with the results. A standing wave is created by acoustic conditions that render the auditorium resonant to some specific frequency. When that frequency is played alone and continuously the volume picked up by the test microphone will be very much higher than normal. However, when the same frequency appears momentarily, mixed with many others, as in normal reproduction, the same effect

is not produced, or at least not to the same extent.

In tests of the type just mentioned, therefore, the test reel or test signal generator deliver two frequencies, changing from one to the other in quick succession. The result is best read with an oscilloscope, a device that makes a luminous moving picture of the sound wave; or with a recording oscillograph, in which an oscillating pen—point or other means traces a record of the wave on a moving tape. In either case, volume is read by measuring the height of the wave.

The operation of oscilloscopes, which have recently become available at low cost, warrants attention. The indicating light beam, electron beam or other moving element is given a constant motion, say from left to right, at a definite rate of speed. On reaching the extreme right of its range the beam leaps almost instantaneously to its starting point, where it begins a new sweep to the right.

This process continues as long as the instrument operates. Meanwhile, the indicating point of light or other indicator can be made to move up or down (without alteration of its horizontal motion) by the voltage to be measured. Therefore, the indicating point traces a wave similar to the illustrations of alternating currents that are used in standard textbooks of electricity. The height of that wave, the extent to which the beam is deflected, measures the deflecting voltage. Since the *horizontal* motion, the sweep motion, is constant, the spacing of the waves on the viewing screen measures the number of times per second that the beam changes its direction of *vertical* motion, and therefore measures the sound or other frequency. Irregularities in the pattern of the wave indicate the presence of harmonic or other supplementary frequencies, and wave-form distortion in general.

Apparatus for such thorough measurement of sound quality not being available usually to theatre personnel, these tests and adjustments based on them can only be made by servicing organizations. They indicate, however, the ideal to be approached in other tests, which can be and are made by the theatre.

The standard volume indicator test is familiar to almost all projectionists. A test reel, carrying individual frequencies, is operated through the sound system and into the decibel meter, which is connected to the speaker circuit. Acoustic conditions do not enter into the results as shown—hence no precaution against standing waves is necessary. The test is obviously inconclusive with respect to results as heard by the audience, since it omits not only acoustic complications but also the nature of the response of the speakers. Speakers do not turn all frequencies into audible sound with exactly the same efficiency, and frequency discrimination in their response is not shown by a meter connected to their input circuit.

Here Fig. 1 comes to the assistance of those theatres equipped with the types of systems to which it applies. With its help it is possible to use a decibel meter to determine overall response *including* speakers — the chart supplies the necessary correction. The system is adjusted to produce, in the meter, one of the four curves shown. When that curve has been attained, sound *leaving* the speakers will be exactly right for the new recordings (Table A.)

The chart will show that the desired low-frequency response, with the new recordings, is —1 db at 50 cycles as compared with the 1,000-cycle response; with the Mirrophonic systems speaker action requires that the 50-cycle decibel meter reading be raised 2 db to +1. With all other systems here included, however, the 50-cycle reading must be depressed to —3. The difference decreases to 1 db each way at about 75 cycles, tapering until at 200 cycles all systems read alike, which is zero with reference to their 1,000-cycle reading.

At the upper end the metal diaphragms are obviously more efficient, since they give proper results when the decibel meter reads —18 at 8,000 cycles. Where bakelite diaphragms are used the equipment must be adjusted to read —10 at the same frequency. The difference between efficiencies makes its appearance just below 2,000 cycles, and increases progressively thereafter.

These measurements are taken at the output of the *low*-pass filter.

The Academy offers this chart as satisfactory only for theatres of average acoustics. Others may find that results with the chart do not give the best possible quality, that different adjustments are needed, and will have to be made with either the elaborate test apparatus mentioned previously, or with hearing tests as described hereafter.

For Average Acoustic Conditions

In theatres of average acoustics, using any two-way systems covered by Fig. 1, the Academy further suggests that the output of the *high*-frequency filter may be reduced as follows: Mirrophonic systems, from 2 to 4 db; RCA systems, from 0 to 2 db.

Theatre systems not covered by Fig. 1, and theatres that, because of exceptional acoustics do not get the best possible results therewith, can improve reproduction by relying on the human ear, with certain obvious precautions. Do not rely upon the ear of any one individual, whether a sound engineer or the owner of fifty theatres. Of course, a sound engineer whose hearing has been measured and charted knows his own defects, and can make allowances for them. *No one else, unless seriously deafened, knows whether his hearing is normal.* How can one tell? Hearing tests for quality are made by groups, on the sensible basis that what is wanted is sound to please the average ear; and the janitor's vote of quality should count for exactly as much as any other.

Lows and highs are easy to recognize. Lows give body to the sound, but an excess of them makes sound "tubby" or "barrelly." Highs are heard in "s," "f," "sh" and "ch" sounds; they make it possible to distinguish the individual instruments of an orchestra. Any extensive absence of either will make sound unnatural.

Hearing tests, equally with the more

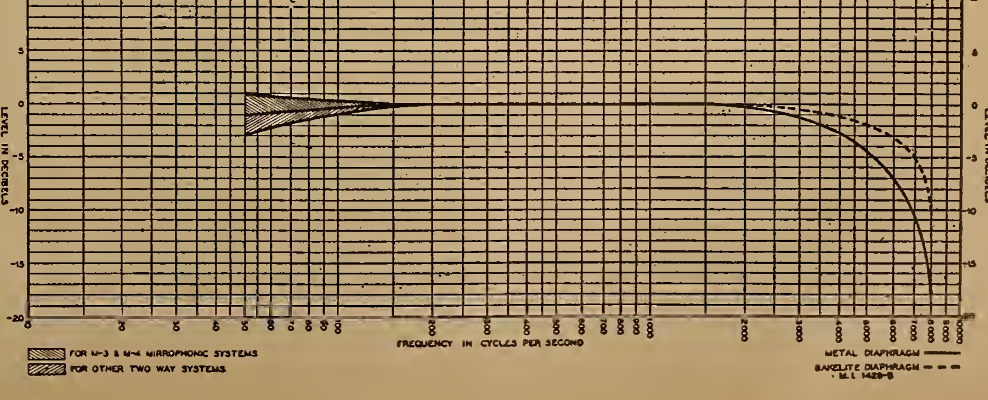


FIGURE 1

Graph of electrical run under new recording standard

complex microphone and oscilloscope tests, must be applied in several parts of the auditorium, and satisfactory conditions found in one location must be checked in all parts of the house.

In one-way systems—that is, systems that have one or more speakers, but all of the same type—place the ear as close to the speakers as possible. In two-way systems the ear should be placed between a low- and a high-frequency unit, somewhat nearer to the latter; but results in any case will not be accurate, since they depend on the exact location chosen for the ear. Headphones are useless—they do not have the frequency range of modern sound reproduction. Those of the crystal type are best in point of quality, but being of very high impedance are difficult to match to any output circuit in an average system.

In hearing tests the effect of successive adjustments in altering low- and high-frequency response is noted and used as a guide toward obtaining the most pleasing balance. Different results in various parts of the auditorium are compared.

Speaker Distribution Adjustment

When results in the auditorium vary widely, it may prove advisable to adjust the system for the best sound at the speakers themselves, and then re-point them to distribute the sound as evenly as possible. On the other hand, it may be advisable to adjust for relatively poor sound at the speakers, and then re-point. Every theatre presents an individual problem; no general rule is possible.

The problem in the projection room is, of course, to vary the volume of input to the speakers at different frequencies, the extent of such variation being guided by microphone and oscilloscope tests, decibel meter tests with the help of Fig. 1, or hearing tests. The electrical arrangements used to secure such variation depend upon the design of the system.

Two-way sound systems of the type covered by Fig. 1 are equipped with frequency-selective filters wired into the speaker circuits. There are several types of such filters, but substantially all of them are equipped with simple means for controlling their action with reference to broad bands of frequencies. The control often consists of a series of soldered tap connections, and a soldering iron is needed to shift the controlling contact from one tap to another.

One-way systems are often equipped with tone controls, which may or may not be adequate for providing the extent of adjustment required. Some of these controls act by turning a knob or dial. Some involve shifting of soldered connections in the circuit of an amplifier. The manufacturer can advise whether his equipment is built with frequency selective circuits of any kind, and if so, how they should be used.

Some sound systems have no frequency controls for adjustments in theatres, while others have controls that may prove insufficiently variable. Thus, the listener might demand still further suppression of the lows even after the projection room has applied maximum compensation. In this case, as when there are no frequency controls, external apparatus must be added.

The additional equipment required will sometimes be furnished by the manufacturer of the original installation. It may be wired into the speaker circuit, or built into the amplifier as a modification, or added to the p.e. cell circuit. Where the manufacturer does not supply such apparatus, it can be obtained from many firms specializing in electrical, sound or radio equipment. Complete information as to the nature of the controlling action desired, and as to the circuits in which it must operate, should be given.

A somewhat crude form of frequency control, which may prove adequate, especially when used only to supplement existing facilities, is to modify the focus of the exciter lamp. Anything less than the best possible focus reduces the high-frequency response and brings up the lows by comparison. On the other hand, the highs are emphasized not only by the sharpest possible focus but also by scrupulous cleanliness of the optical system and photo-cell, and by frequent changes of lamps, using only those that are substantially undarkened and have filaments entirely straight when hot. (A magnifier and colored glass, or colored gelatine, may be used to make sure the filament has not sagged in operation, which some filaments do, although straight while cold.)

There are several "hay-wire" methods of modifying frequency response: highs can be cut down drastically and lows increased by connecting a small condenser across the loudspeaker input transformer or voice coil. This procedure is inadvisable unless carefully designed, as the whole middle band of frequencies may be affected unfavorably. It is always preferable to design or buy a true frequency-selective filter to do exactly what is required of it, and no more.

A better method is to change the loudspeaker baffles. In the case of flat baffles, for example, increasing their area in all directions will increase low-frequency response; decreasing that area will reduce such response. The same is true to some extent of trumpet-shaped baffles, but in this case other factors may complicate the results. Trumpet-shaped baffles can be modified, however, by adding a short strip of wood or other suitable material along the top, or along one side, to deflect the sound away from some surface of the auditorium, and thereby reduce an acoustic complication.

• *Letters to the Editor* •

The West Coast Preens Its Gorgeous Feathers

Regarding the article in April issue by S. E. Anderson, titled "Theatre Film Fires," p. 15. It is regrettable that this man used his affiliations when he signed the article, because anyone unfamiliar with the I. A. might thereby assume that his personal opinion was authentic. You will note that I say opinion, and not experience. I read the article twice, and then looked at the cover to make sure I wasn't reading Grimm's Fairy Tales. I am firmly convinced that he has a highly developed sense of imagination.

I suggest that he visit a supply store and view a projector that has really gone through an 1800-foot film fire. He says that the fire was hot. That statement is one of the few that is entirely correct. As to his fire, I will pass over it lightly, as it is obvious that he wasn't present at the time. However, if I am wrong, and it really happened, I will say that he was fortunate to have plenty of peroxide handy, as well as plenty speedy to be able to clean up so quickly as to have five minutes left over.

He says that the firemen were amazed when he threaded up the burned projector. Aren't we all? He probably did have a fire and burned 18 inches, which in recounting many times has turned out to be 1800 feet. As Groucho Marx said, "You know how those things are, they multiply like rabbits."

As to his projection room design, it undoubtedly is Class A for his town, but could hardly be used in this territory. We of the Pacific Coast enjoy what are considered really fine projection rooms. Many men have devoted years of their lives to designing them, and the plans they have laid down, being improved by time and experience, have produced projection rooms which stir the profound admiration of those who are aware of their existence. Foremost among those who have unstintingly spent their money for this purpose is Fox West Coast Theatres, Inc. This company boasts the services of a recognized authority in the person of R. H. McCullough, Chief Sound and Projection Engineer, who designs these

modern rooms which are a triumph of projection engineering both as to completeness and efficiency. Needless to say, they do not look like Mr. Anderson's.

Personally, I cannot understand bringing hot air from the roof, over a bank of heated ballast resistors, into the room and calling it a fresh-air supply. Our State laws would not permit it. There are many legal objections to his design. For example, an open rewind, one exit, no toilet (or do they still use logs in Wisconsin?), a motor generator set not isolated, *etc., etc.* In conclusion, I can fully sympathize with Mr. Anderson's urge to write the article (we all get a bit fictional at times) but he shouldn't have mailed it.

T. B., California

Foregoing is typical of many letters received on same topic. Since Mr. Anderson's room departs so far from standard, there need be no further discussion on that point. Personally, however, we wouldn't take from a policeman that which T. B. of the snooty West Coast hands out to Wisconsin. Obviously, projection rooms in California are no less wondrous than its climate, scenery and real estate.

Suprex Carbon Pitting

I am having a rather trying time with Suprex carbons, and I seek enlightenment. Probably the many projectionists in your locality who are using these carbons have experienced the same trouble as I am having at present. Is there any way of overcoming the spitting action by the positive?

My procedure is as follows: I strike my arc four to five minutes before change-over, and nine times out of ten the crater by this time has settled down, the floor being in perfect shape. Any time from the beginning of a reel to its finish, the positive starts a period of spitting lasting anything from one to five minutes, and then just settles down again. Besides the bad effect in the light of the screen image, it doesn't do my mirrors any good. I am using a copper-oxide rectifier. I would be very much obliged if you could give me some information in this respect. Carbons are baked before using.

G. C. Gregory
Wellington, New Zealand

This savors of long-distance master-minding, but we'll hazard guess trouble is due to neither rectifier nor dampness in carbons. Baking before using would eliminate latter. Uniformity, goal of all manufacturers, is doubly important in carbon-making. Sounds like a poor lot of carbons, trouble from which will disappear with last of batch—certainly by the time this I. P. reaches N. Z. Same trouble in U. S. occasionally, and nothing can be done but take it.

I. P. Goes to College

My I. P. is whisked away from me immediately it arrives each month. My son attends the Univ. of British Columbia, and they have a radio and sound club. Result: the club reads I. P. before I do, because they find your diagrams invaluable. Noted where Nebraska killed bill for projection room lavoratories. Here in B. C. such a law has been in force for 12 years. Nebraska boys should gather up all such laws of other states for presentation to their horse-and-buggy legislators.

After looking at some shots of Southern U. S. theatres we realize that we have just as good, if not better, here in B. C. Will forward a print soon to prove it. Keep up your good work for the film-grinders.

W. A. Crile
L. U. 348, Vancouver, B. C.

No, Nebraska boys should force legislators to work a few tricks and see how *they* like it.

A Gentlemen's Agreement

I agree with W. Hoy, of Calgary, Canada, that I. P. should devote a page for equipment (sound and visual) troubles and their remedies. If each man would write a short letter detailing his trouble and the remedy therefor, we could help each other considerably. A good name for this page would be "Service."

Leonard T. Banta
Hollywood, Florida

Mr. Banta agrees with Mr. Hoy, and we agree with both of them. The success of such a page (space for which we shall be overjoyed to provide) is dependent on field contributions, the dearth of which to date indicates that positively nothing ever happens to disturb projectionists' serenity. Without a flicker of playfulness, we suggest that Messrs. Hoy and Banta provide the first contributions to start the page off.

STEPS IN THE MANUFACTURE OF MOTION PICTURE FILM

By *DR. E. K. CARVER*
RESEARCH LABORATORY, EASTMAN KODAK COMPANY

A brief account of some of the more important phases of manufacturing motion picture film, tracing the product through the plant from the raw materials to the finished product. Originally presented before the S.M.P.E.

THE business of manufacturing photographic film is a peculiarly pleasant one for the technical man. There are three principal reasons for this: first, most of the progress in this industry is based upon scientific research of a fundamental character; second, there is a wide variety of technical problems, so that there is almost unlimited scope for technical skill, and third, due to the care required in handling all the materials involved, the type of workmen attracted to this industry is such that it is always a pleasure to be associated with them.

The different positions from which the manufacturer of motion picture film may be viewed is exemplified by the two expressions, "film base" and "film support." Both these expressions mean the same thing, but we find that one of them is used chiefly by the emulsion makers, and the other chiefly by the support makers. To the emulsion maker, the film support is nothing more than its name implies—a transparent material upon which he may coat his carefully prepared emulsion. Among the makers of the support, however, this material is ordinarily referred to as the "base." They not only speak of it as the base, but they think of it as the basic material upon which is coated a thin layer of a creamy material before the base is ready for use.

From the point of view of the emulsion coater, both the base and the emulsion are simply raw materials, fairly simple in their properties, although one of them possesses the extremely annoying property of being sensitive to light, to abrasion, to high temperatures, to over-drying, to under-drying, and, in fact, to almost every possible variation in handling.

Cooperation by Large Group

To the machine designer, motion picture film is made by machinery, the workmen merely feeding and tending the machines. To the workman, the film is manufactured in distinct steps, each step being a separate and distinct job in which he takes pride in being a specialist. From our point of view, then, motion picture film is manufactured by the coordinated efforts of a large number of separate units. This coordination implies cooperation, and it is this feature of the work especially that contributes most to the pleasure of working in the film industry.

Film manufacturing may be divided into two main phases. One has to do with emulsion making, which includes gelatin manufacturing and the preparation of the emulsions for coating. The other includes all other departments connected with the manufacture of film—namely, the Chemical Plant, where the cotton is nitrated, the solvents distilled, and the dopes mixed; the Roll Coating department, where the dope is coated into transparent sheets of film support; the Emulsion Coating department, where the emulsion is coated upon the film base; and the Finished Film department,

where the film is slit, perforated, and packed ready for shipment.

The raw materials used in the manufacture of nitrate film support are cotton linters, sulphur, sodium nitrate, camphor, and solvents. For safety support they are cotton linters, acetic anhydride, acetic acid, triphenyl phosphate, and solvents. For the emulsions they are hides, silver, nitric acid, potassium bromide, and sensitizing dyes.

The cotton linters used for the manufacture of cellulose nitrate are prepared from the short fibres of the cotton plant obtained by means of a special cutting machine from the cotton seeds after ginning. They are prepared for nitration at the various plants in the South by special treatment with caustic soda and hot water. Careful control of the treatments is necessary in order that the cellulose nitrate be suitable for nitration.

The Nitrating Plant is arranged to follow the gravity system. The linters, upon arrival, are taken to the top floor of the building. There they are put in a combined picking and drying machine, where the bales are torn apart by means of saw-teeth and brought to a uniform and low moisture content by means of controlled drying. From the drying bins the cotton is weighed out and placed into chutes, ready for immersion in a nitrating bath.

These nitrating baths, or pots, are steel containers with special rotating stirrers which will quickly immerse the cotton beneath the surface of the acid contained in the pots. The acid is a specially controlled mixture of sulphuric acid and nitric acid containing definite amounts of water. The water content is the chief factor in controlling the percentage of nitrogen in the nitrocelluose, although, of course, the sulphuric acid and nitric acid also must be in the right proportions.

After nitration for a definite length of time at controlled temperature, the nitrocellulose and acid are dumped through a pipe into a centrifuge on the floor below. Four nitrating pots will take care of one centrifuge. The centrifuge is made of stainless steel and is used to remove the acid from nitrocellulose. After as much acid as possible has been removed by centrifugal force, the operator opens the centrifuge, and by means of a long spatula, removes the cake of nitrocellulose from the sides of the basket and dumps it through the bottom into a rapid stream of running water which carries it into wash tanks.

Removing the Residual Acid

In these wooden wash tanks, the nitrocellulose, or "cotton" as it is generally called, is subjected to many changes of hot water to remove the residual acid. The stability of the nitrate depends to a large extent upon the thoroughness of this washing operation. The nitrocotton is stored in a wet condition until ready for use, when it is dehydrated by means of another centrifuge which removes most of the water by centrifugal force. By washing in this same centrifuge with butyl alcohol, the remainder of the water is removed. The dehydrated nitrocellulose is put into specially insulated metal cans and taken to the Dope department, where it is mixed with solvent to form dope. The solvents most used for making nitrate films are methyl alcohol, ethyl alcohol, acetone, and sometimes alcohol and ether.

The dope mixers are large tanks equipped with paddles rotating in opposite directions and driven by powerful gears. Into these mixers the nitrocotton and solvents are placed, and the paddles rotated until a clear, uniform dope is obtained. From one mixer the dope is pumped through filters to other mixers for further mixing and filtration. In these mixers camphor, or triphenyl phosphate in the case of cellulose acetate film, is blended with the dopes to plasticize and stabilize the finished film. The finished dope has much the appearance of clear, strained honey.

From the Dope department, the solutions are pumped to the Roll Coating department, where they are coated or cast into the form of film support. In the roll coating machines, the dope is spread, by means of a hopper or trough having a narrow slit at the bottom, upon the upper surface of a large, slowly rotating polished wheel. These wheels vary from about 12 to 18 feet in diameter and from four to five feet in width. As they slowly rotate, a current of hot air is passed around their periphery, evaporating the solvents from the dope, so that by the time the dope has made almost one revolution, coating is dry and is ready to be stripped from the wheel.

After stripping, it passes over a long series of small rollers or drums, for the final curing operation. As it passes over these drums, various layers of other materials are usually applied. One of the applications which is almost universal in making photographic film, is a substratum of thin gelatin. This substratum is necessary in order to make the emulsion adhere firmly to the film support. For certain types of film, antihalation backings or tints may also be required.

The air leaving the roll coating machine contains a certain amount of solvent which must be recovered if the process is to be economical. Of the various methods of solvent recovery used, water scrubbing, activated charcoal, and refrigeration are the most common, and refrigeration is generally regarded the most satisfactory, due to the fact that during refrigeration the air is also dehydrated and brought to a uniform condition. The finished film support is then wound into rolls, put into metal cans, and stored in cool rooms until ready to be coated with the emulsion.

Silver for Emulsion Making

The principal raw material for emulsion making is silver, which comes in the form of ingots. These ingots are dissolved in nitric acid and the resulting silver nitrate is recrystallized several times in distilled water in large porcelain dishes. Specially selected gelatin, chosen not only with regard to its physical properties, but also for its effect upon the photographic quality of emulsions made from it, is the other important raw material used in emulsion making. The silver nitrate is precipitated in the presence of gelatin, by means of potassium bromide, iodide, or chloride in a water-jacketed kettle provided with a stirrer. The gelatin is then set by being chilled in water and pressed out in the form of spaghetti in an emulsion press. These strips or rods of emulsion are soaked in distilled water to wash out the residual salts. After ripening and other special treatments, such as the addition of sensitizing dyes, the emulsion is ready for coating.

The emulsion-coating operation is similar in many of its details to coating other fabrics, such as artificial leather, gummed paper, *etc.*, except for the requirements of cleanliness, uniformity, and the fact that the operation must be done in the dark. The operation is carried out by passing the film support, subbed side down, beneath a roller partly immersed in a pan of melted

(Continued on page 25)

Forerunner of Modern Projector Shown in N. Y.

A "guioco di luce," or "play of light" device, one of the earliest known forerunners of the modern motion picture projector, is among the recent acquisitions of the Cooper Union Museum for the Arts of Decoration in New York City.

Apparently constructed about 1780 for King Vittorio Amadeo of Savoy and his Queen, Maria Antoinetta, whose ciphers appear together on one of its interchangeable designs, it is a cabinet 30" high, 22" wide, and 12" deep, covered with Italian wallpaper of the period. Its effect depends on the synchronization of light and movement. A lamp is arranged inside to shine through cards pierced in flowing designs and turned by a sandwheel.

The only machine of its kind ever brought to America and one of the few known to exist anywhere, it was purchased from a French dealer who discovered it in a mass of odds and ends in an old French chateau. It is dated by its covering wallpaper and by rhymed couplets inscribed in faded Savoyard Italian on the backs of the cards, one of which bears the legend. "Vive la Maison Royale de Savoie."

A NEW ZERO-CURRENT METER FOR PROJECTION ROOM USE

By *ROBERT GARWIN*

MEMBER, PROJECTIONIST LOCAL UNION 160, CLEVELAND, OHIO

SINCE the inception of radio, and, later, sound projection systems, with their multiplicity of circuits carrying extremely small values of current, the crying need of the serviceman has been a meter so sensitive that its connection to a circuit would not disturb the values of current and voltage existing in that circuit, by virtue of the fact that the meter itself requires some current for its operation, the value of that current depending to a large extent upon its sensitivity.

This meter-actuating current must, of course, be drawn from the current supply, and passes through the circuit to the point at which the meter is connected. If, as is usually the case, there are resistors in the circuit through which the current must pass to reach the meter, then this meter-actuating current will cause a voltage-drop to be developed in these resistors, which would not be present if the meter were not connected to the circuit.

This voltage-drop naturally lowers the voltage at the point of connection to the circuit element (plate, screen or grid), being supplied by this current and disturbs the operation of the entire circuit to the extent to which the particular element is sensitive to a change in voltage. The amount of circuit disturbance caused by the connection of a meter depends upon two factors: first, the relation of the value of the meter-actuating current to the value of the current normally flowing through that circuit—that is, in a circuit already carrying a fairly heavy current, the addition of a small meter current will be almost, if not entirely, negligible. The second factor governing circuit disturbance is the sensitivity of that particular circuit element to which the meter is connected to a change in voltage.

Effect of Voltage Variation

In a heater circuit the voltage can be varied considerably without creating any disturbance in operation; also, to a large extent, a transformer-coupled plate is insensitive to voltage variation. On the other hand, a resistance-coupled plate is quite sensitive to voltage change, and a grid is extremely sensitive, inherently, to any change in bias voltage and requires accurate adjustment of such bias voltage for undistorted operation.

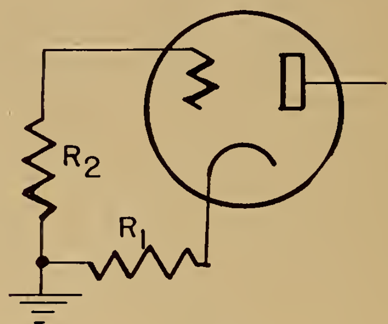


FIGURE 1
Typical Grid Circuit

For example, with a 5-volt filament circuit normally carrying 1 ampere, the connection of even a low-resistance voltmeter of 100 ohms per volt would, if the 10-volt scale were used, add .005 of an ampere to the current normally flowing and would introduce a completely negligible additional voltage-drop. Of course, a meter having a higher resistance (1000 ohms per volt or more) would mean an even smaller additional voltage-drop. However, in a plate circuit carrying 1 mil through a 50,000-ohm resistor from a plate supply of 250 volts, the normal voltage-drop would be 50 volts and the voltage at the plate would be 200, normally. The connection of a 100-ohms-per-volt meter to the plate using the 250-volt scale, would parallel the apparent resistance of the tube (which is 200 volts divided by .001 ampere, or 200,000 ohms) with the resistance of the meter (which is 25,000 ohms for the 250-volt range). The combined resistance would be:

$$\frac{1}{\frac{1}{200{,}000}+\frac{1}{25{,}000}}=\frac{1}{.000005+.00004}=$$

$$\frac{1}{.000045}=22{,}222\text{ ohms.}$$

This resistance in series with the 50,000-ohm plate resistor offers a total resistance of 72,222 ohms to the flow of current. The actual current flow would then be:

$$\frac{250}{72{,}222}=.0035\text{ ampere}$$

which would cause a voltage-drop in the plate resistor of 50,000 x .0035 = 175 volts. This drop subtracted from the plate supply of 250 volts would leave only 75 volts at the plate of the tube, which would completely upset the operation of the tube.

It can readily be understood, then, that the 100-ohm-per-volt meter is absolutely worthless when measuring plate or grid voltages. If, instead, a 1000-ohms-per-volt meter were used in the aforementioned plate circuit, some disturbance would occur, although to a lesser extent. The meter resistance on the 250-volt range would then be 250,000 ohms, which, in parallel with the apparent tube resistance of 200,000 ohms, would give a combined resistance of:

$$\frac{1}{\frac{1}{200{,}000}+\frac{1}{250{,}000}}=\frac{1}{.000005+.000004}=$$

$$\frac{1}{.000009}=111{,}111\text{ ohms.}$$

The current flow would now be:

$$\frac{250}{50{,}000+111{,}111}=.00155\text{ ampere,}$$

which would develop a voltage-drop in the plate resistor of 50,000 x .00155 = 77.5 volts, leaving a voltage at the plate of 250 — 77.5 = 172.5.

Of course, this is not the true value of plate voltage when the meter is not connected, but the circuit disturbance caused by the drop in plate voltage from 200 to this value would probably not be of any great consequence. It

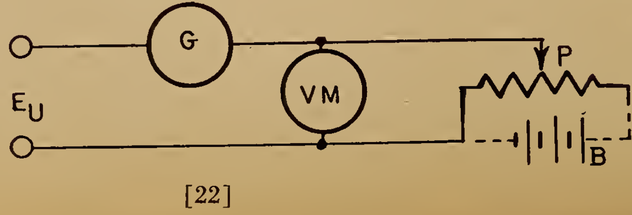


FIGURE 2
Elementary circuit of zero-current meter

may be assumed, therefore, that for measuring plate voltage, even in resistance-coupled circuits, the 1000-ohms-per-volt meter is satisfactory and gives a reasonably accurate approximation of the actual plate voltage.

Grid Circuit Very Sensitive

The most sensitive part of the vacuum tube circuit is that portion designated as the grid circuit. The grid is supplied with a bias voltage, usually from a biasing resistor in the plate return circuit. This bias voltage is supplied to the grid through a grid resistor, the value of which usually ranges from 100,000 ohms to 1 megohm, although in some cases it is as high as 10 megohms. Assuming that it is desired to measure the grid-bias voltage of a tube in a circuit such as shown in Fig. 1, it is necessary to examine the conditions set up by the connection of a meter to the circuit.

In normal operation the plate current flow through the bias resistor R_1 of 1000 ohms is 5 mils, causing a voltage-drop in R_1 of 1000 x .005 = 5.0 volts. This bias voltage is supplied to the grid through R_2 of 500,000 ohms resistance. Since there is no current flow from the grid, there is no voltage-drop in R_2 and the full bias voltage is available. However, in measuring the grid bias voltage at the tube, if a 1000-ohms-per-volt meter is used, on the 10-volt range, it inserts a resistance of 10,000 ohms between grid and cathode, thus completing the circuit. The grid bias of 5 volts is now impressed on a closed circuit consisting of the grid resistor, the meter resistance and the bias resistor. The current flowing in the circuit is:

$$\frac{5}{500{,}000 + 10{,}000 + 1000} =$$

$$\frac{5}{511{,}000} = .0000098 \text{ ampere.}$$

This current causes a voltage-drop in the grid resistor of 500,000 x .0000098 = 4.9 volts, leaving a drop across the meter of .1 volt, which is what the meter will read and which will be the actual bias voltage on the grid as long as the meter is connected. Naturally, it is impossible to accurately determine the true grid bias voltage with such a meter.

FIGURE 4
External view of zero-current voltmeter, showing various connections and controls as well as overall arrangement within carrying case

Development of more highly sensitive meter movements has proceeded steadily in the search for measuring instruments that would operate on less current. The 50-microampere meter movement has a resistance of 20,000 ohms per volt, and of course gives a closer approximation to the true voltage than the 1000-ohms-per-volt meter. Using this meter on the 10-volt range to measure the grid bias voltage in the circuit previously discussed, the current flowing would now be:

$$\frac{5}{500{,}000 + 200{,}000 + 1{,}000} =$$
$$.0000071 \text{ ampere}$$

and the drop in the grid resistor would be 500,000 x .0000071 = 3.55 volts, leaving a voltage at the grid and across the meter of 1.45 volts. This value, while higher than the .1 volt read by the 1000-ohm-per-volt meter, is still a very poor and inaccurate approximation of the true grid voltage, and renders even this highly sensitive meter useless for this purpose.

Engineers of the Hickok Electrical Instrument Co., of Cleveland, while engaged in research devoted to the design of highly sensitive voltmeters for accurately measuring grid voltage, finally decided that any meter which draws any current whatsoever from the grid circuit through the grid resistor will inevitably cause a comparatively high voltage-drop in the grid resistor, which will cause the voltage reading at the grid to be so inaccurate as to be worthless.

They then decided to build a voltmeter that would draw absolutely no current from the circuit the voltage of which is being measured. The result is the Hickok Zero-Current Voltmeter, a unique instrument that actually draws *no* current from the circuit to which it is connected and therefore causes *no* drop in the grid resistor. The result is that this voltmeter reads the grid bias voltage at the tube as the accurate and true grid bias.

The principle of this meter is simple —in fact, so simple that one wonders that it had not utilizied far sooner. In another form it has been in use in electrical laboratories for many years. The principle employed is that of the bridge circuit, in which an external unknown voltage is opposed to a point of balance by an internal adjustable voltage. The elementary circuit is shown in Fig. 2.

The unknown voltage which is to be measured is connected at Eu. The potential of the battery B is varied, in effect, by the potentiometer P. When

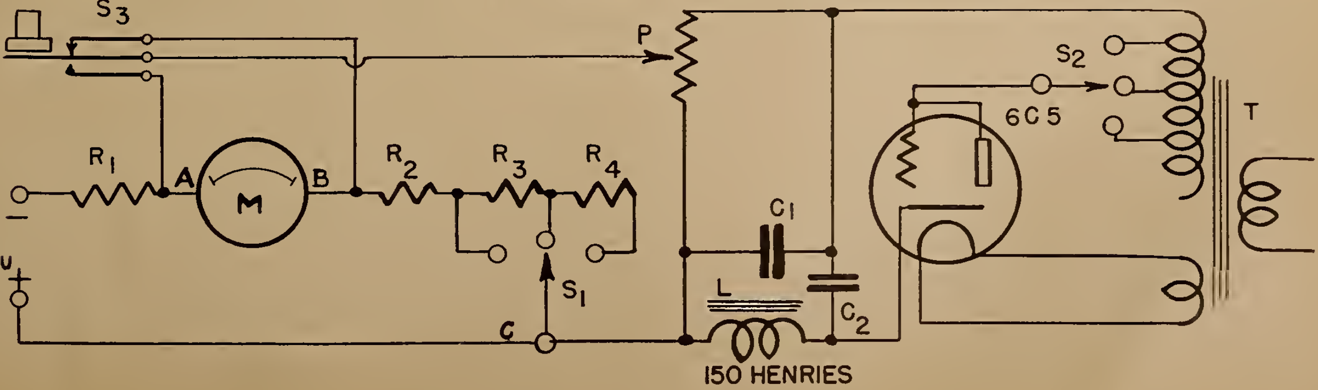


FIGURE 3. *Zero-Current Voltmeter*

P is adjusted so that the galvanometer G reads zero, the unknown potential has been exactly equalled by an opposing potential from the battery. Therefore no current flows through the galvanometer either from the unknown voltage source or from the battery. If any current is flowing, the galvanometer will not read zero, showing that the battery voltage is not exactly equal to the unknown voltage and must be adjusted. When the galvanometer reads zero, the voltmeter Vm reads the effective voltage of the battery, which is exactly equal to the unknown. It must be understood that the current actuating the voltmeter is supplied by the battery alone—no part of this current flows as a result of the unknown voltage.

The actual circuit of the Zero-Current voltmeter has been designed somewhat differently from that shown in Fig. 2. Batteries have been eliminated and replaced by a transformer and rectifier tube (6C53). The galvanometer has been eliminated and instead the moving coil of the voltmeter is used as a galvanometer.

This coil is used first in one circuit and then transferred to another, after the voltages are equallized, in order to read the adjusted voltage from the power unit. This transfer is accomplished by a push-button switch which disconnects the moving coil from the series circuit, between the opposing voltages, and reconnects it to the power unit circuit, *which has ample capacity to operate the meter without voltage-drop.* In this instrument it is possible for the first time to obtain conveniently and simply, at the grid of the tube, the true and accurate bias voltage, instead of what in the past has always been, even at best, a very poor approximation.

The actual circuit of the Hickok zero-current voltmeter is shown in Fig. 3.

How the Meter Operates

The power transformer "T" is connected, by a cord and plug supplied in the instrument, to any 110-Volt, 60-cycle outlet, and furnishes filament and plate to the metal tube 6C5 used as a rectifier. The plate voltage is adjustable in three steps by the switch S2. The filter circuit consists of the condenser C2, the 150-henry choke and the second condenser C1. This part of the circuit replaces the battery B in Fig. 2. The potentiometer P, in connection with the switch S2, allows the internal voltage to be smoothly and continuously varied from 0 to 250 volts.

S1 is a range selector switch, permitting the use of any of three ranges: 0-10, 0-50 and 0-250 volts by connecting one or more of the multiplier resistors, R2, R3, R4 into the circuit, and is ganged with S2 in such a manner that as S1 is moved to a higher range, the plate voltage at the rectifier is correspondingly increased.

In operation, the unknown grid voltage is connected at Eu, and attempts to send a current through R1, the meter M, and then through that portion of a resistor group R2, R3, R4 that is in the circuit, then down through the blade of S1, to the left in the bottom wire and so back to Eu. At the same time a current is flowing from the power unit through the potentiometer P, to the left to S3, into the top spring of S3, then to the right and down to the resistor group, through S1 and back to the power unit.

This internal current, in passing through the resistors, causes a voltage-drop across them, which can be measured between the points B and C. This voltage is of the same polarity as the external voltage which is applied at A and C. Therefore, if the potential between A and C is, for example, 10 volts, while that between B and C is only 9 volts, then A is 1 volt higher than B, and a current will flow through the meter from A to B, causing it to deflect, let us say, to the right. However, the internal current can be varied by the potentiometer P, thereby varying the accompanying potential drop across the resistors and between B and C.

If this potential is thus raised to 11 volts, then B will be 1 volt higher than A and a current will flow through the meter from B to A, thereby causing it to deflect to the left. If, by means of the potentiometer, the potential between B and C is caused to become exactly equal to the external potential as applied between A and C, then the points A and B will be of exactly the same potential and no current will flow through the meter, which will indicate zero deflection or zero current, showing that absolutely no current is flowing through the external circuit and therefore no potential drop is developed across the grid resistor in the circuit being tested.

When the balance has been attained, the switch S3 is depressed, which throws the internal voltage—without in any way changing its value—across the meter movement in series with its proper multiplier resistors. In other words, instead of acting as a galvanometer as before, it now becomes a voltmeter and measures the internal voltage which previously was balanced to equal the external voltage. In this manner it is possible to measure grid bias voltage at the tube at its true value.

This zero-current voltmeter is built into an extremely compact and convenient testing instrument, the Hickok Model SG, 4800-E. It is a one-meter unit and is built for use either as a point-to-point tester or as an analyzer. A multi-selector socket unit capable of holding any type tube is built in and all necessary cords and adapters are

TABLE A

Comparative Voltages as Read With Various Meters

	Circuit Element	Meter 1000	Ohms-p.-v. 20,000	Zero Current
RCA MI—4241 Voltage Amplifier	6C6 Control Grid	1.2	1.4	1.7
	Screen Grid	23	45	54
	Plate	137	163	178
	1st 76 Control Grid	1.3	4.6	6.3
	Plate	122	131	135
	2nd 76 Control Grid	1.7	7.1	12
	Plate	227	234	239
	45 Grid	43.8	44.5	44.5
	Plate	262	262	...
	45 Grid	43.8	44.5	44.5
	Plate	265	265	...
Erpi 46 Amplifier	1st 264-A Grid	4.1	5.7	6.95
	Plate	65	70	72
	2nd 264-A Grid	.4	4.7	8.50
	Plate	70	83	88
	205 Grid	4.8	27	37
	Plate	400	400	...
	205 Grid	4.8	27	37
	Plate	390	390	...
Erpi P.E.C. Amplifier	Photocell	9.5	32	94
	1st 264-A Grid	0	.1	5.5
	Plate	57	61	62.5
	2nd 264-A Grid	.6	4.8	7.2
	Plate	82	83	83

Showing practical projection room application of new zero-current voltmeter

furnished. The testing circuits, such as Capacity, Resistance, *etc.*, are selected by the single selector switch. Range selections in each circuit are made by means of rows of pin jacks designated by the pointer knob of the selector switch.

The various testing functions and ranges provided by this instrument are as follows:

D.C. Voltmeter: 5 ranges of 0-10, 0-50, 0-250, 0-500, 0-1000 volts, all at 1000 ohms per volt.

A.C. Voltmeter: Same ranges and sensitivity as D.C.

D.C. Milliammeter: 0-1, 0-5, 0-50 and 0-500 mils. Also 0-500 Microamperes, D.C. only.

A.C. Milliameter: Same as D.C.

Ohmmeter: 5 ranges covering from .05 ohm to 10 megohms. Highest range operated from built-in power supply.

Capacity meter: 5 overlapping ranges, covering from .0001 mfd. to 200 mfd.

Output meter: can be connected across any type of load.

Zero-current Voltmeter: 3 ranges of 0-10, 0-50, 0-250 volts, in a bridge circuit which draws absolutely no current from the circuit being tested.

In addition, external shunts are available in range of 0-5, 0-25 and 0-250 amperes, making possible the measurement of current of even high-intensity arc lamps. Voltage ranges can also be increased by the use of external resistors, using a one-megohm, one-watt resistor in series, for each additional 1000 volts that it is desired to increase the range.

Figure 4 is a photograph of the Hickok model SG-4800-E testing instrument showing the panel layout. The multi-selector socket unit is of the series pin jack type, in which current and voltage can be measured in any tube element circuit.

Table A gives comparative readings taken with voltmeters of different resistances, on typical circuits.

It is readily apparent, from a brief study of the values set forth in this table, that in those circuits having therein the highest value resistors, and in normal operation carrying little or no current, the potential-drop caused by the connection of any meter which requires any current for its operation is so great in proportion to the total available voltage as to cause the meter reading to be entirely worthless. This is most strikingly shown in grid circuits in which high value limiting resistors are used, and demonstrates the futility of using, in checking such circuits, anything but a zero-current voltmeter.

THE MANUFACTURE OF MOTION PICTURE FILM

(*Continued from page* 21)

emulsion. The speed of travel and the temperature and viscosity of the emulsion govern the thickness of the coating.

Immediately after the emulsion is applied it is chilled, to set it in place, and is then dried under carefully controlled humidity, temperature, and air velocity conditions, by passing the film in festoons through a long tunnel drier. The special devices for forming the loops or festoons are similar to those used in other coating industries. The relative humidity of air used for drying emulsions must be controlled within a very small range to obtain the best results, since the speed of emulsion is sensitive to changes in moisture content. The air that first strikes the emulsion must be conditioned so that the wet-bulb temperature is well below the melting point of the emulsion, in order to prevent the emulsion from running or forming streaks.

For certain types of film, the emulsion-coating operation must be repeated several times. X-ray film and certain color-films have emulsion on both sides, while Kodachrome film requires at least five separate emulsion-coating operations. The coating operation is one in which great cleanliness is required and in which the work is carried out under difficulties, due to the fact, especially in the case of negative emulsions, that most of the work is carried out in almost total darkness.

Slitting and perforating motion picture film appear at first thought to be simple mechanical operations, but in actual practice they are extraordinarily complicated. The slitting is done by revolving knives equally spaced above and below the film. The upper knife has a keen razor edge, while the lower knife has a sharp square edge. Only the finest mechanics are used for maintaining these knives in their proper condition.

Perforating Requires Accuracy

Perforating the film would be comparatively simple if it were not for the extreme accuracy required. The punches and dies are so accurately made that the punches can not be inserted into the dies by hand without injuring them, although when clamped in the machines they go in and out thousands of times without appreciable wear. Each punch consists of eight punching members and eight positioning members, or pilots, four of each on each side of the film.

As the film passes through under the punch, four pairs of holes are made. A shuttle then moves the film four spaces forward, and the ram moves down again. This time the pilots, which have slightly tapered ends, enter the holes that have previously been punched, and finally position the film before the punches strike the new holes, so that each set of eight holes is accurately positioned by the previously punched set of holes. The tolerance ordinarily used in manufacturing the punches and dies is approximately 0.00002 inch.

We have now considered, in as much detail as space permits, the manufacture of motion picture film from the raw materials to the finished product. It is quite obvious that a very great mass of material has been omitted that would have to be presented if the complete story were to be told. Papers as long as the present one would be required to describe in detail merely the problems involved in manufacturing the cores used in the rolls of cine film or of the black paper used in wrapping the film.

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

LABOR troubles in West Coast studios still is top industry news story. Making first pages the country over, the story needs only retouching here. Trouble started when 16 unions outside Basic Studio Pact (painters, scenic artists, costumers, utility workers, makeup artists, culinary workers, *etc.*) formed the Federated Motion Picture Crafts under direction of Charles Lessing, who called a strike. All are A. F. of L. affiliates.

Not only did I.A.T.S.E. and Screen Actors Guild remain aloof, but former was charged with definitely obstructing strike and with "raiding" every other studio craft jurisdiction. FMPC steadily lost strength from first day of strike, and a crushing blow was the deal between SAG and producers, which Lessing charged was engineered by I. A. through "intimidation" of Guild. Support of latter unquestionably would have decided the issue in favor of strikers.

Losing ground through defections of unions which either returned to work voluntarily or made separate deals with producers, Lessing termed I. A. a company union and filed charges with Labor Relations Board and with A. F. of L. against I. A. on "raiding" charges. The evidence seems clear that I. A. lost no time in issuing cards to every classification of studio labor.

Shortly before A. F. of L. board meeting to consider "raiding" charges, I. A. Pres. Browne broke his long silence, called Lessing a Communist and said no peace was possible unless Lessing was ousted. He followed this up next day with blunt statement to effect that any settlement made between studios and FMPC would have to be "satisfactory" to I. A., that I. A. would "dictate" settlement, and that if any secret settlement was entered into without I. A. knowledge and consent, he would issue strike call immediately in all studios and in every theatre in America. No explanation of this unprecedented stand was forthcoming, although the I. A. studio strike in 1932 was denied support.

Following a mass meeting of the SAG, at which v.-p. Harry Holmden of the I. A. pledged unreserved support of the I. A., the FMPC charged that a strike settlement which was about to be signed by the producers was blocked by the insistence of the I. A.

As this is written the A. F. of L. has taken no positive action either for or against I. A. or the FMPC. General belief is that that unit against which the decision goes will bolt A. F. of L. and go C. I. O. The I. A. is likely to stand alone rather than affiliate, but nothing definite on this is known. Possible, if not probable, of course, that A. F. of L. will temporize as usual and stall for time to effect a compromise, Federation stalled so long in 1932 as to ruin I. A. in studios even though another A. F. of L. unit was grabbing all jobs.

Screen Actors Guild deal with producers provides for another one of those peculiar 10-year contracts and "arbitration." A 100% closed Guild shop is due within five years, plus many other concessions of little interest to I. P. readers.

Pres. Browne announced in N. Y. that I. A. now has 35 exchange units organized and set to go. Organization of "front of the house" workers (treasurers, managers, press agents, cashiers, ushers, doormen—in fact, everybody in the theatre that can be unionized) is proceeding rapidly. Next startling news was Browne's emphatic statement that the radio men are next in line for I. A. attention. Serious difficulties with I.B.E.W. may arise therefrom, since this outfit always considered radio its own private domain.

After I. A. winds up its organizing, which evidently is aiming for everything in show business which isn't nailed down (and maybe that, too) the amusement world will be lock, stock and barrel in the I. A. camp, which will then be some pumpkins, looked at from the standpoint of number and calibre of membership.

The Miami airport is quite some swank layout during the winter season, but here is the outfit of James R. ("Books") Cameron as he pushed his way through a maze of dress clothes to bid farewell to Herb (Simplex) Griffin, who was getting away on the late plane. (p.s.: the keepers arrived shortly thereafter.)

Boston Exchange Scales

Typical results of exchange unionization are those embodied in the contract signed in Boston, where wages were upped 10 to 35%. Head shippers will receive $38 weekly, while others will receive $23. Head inspectresses will get $24, and all others $20. Poster clerks are slated for $23, the head clerk getting $28.

Erpi Promotions Announced

G. L. Carrington has been named Commercial Manager of Erpi, and P. T. Sheridan has been advanced to Operating Manager. Carrington joined the Southwestern Bell Telephone Co. in 1920, transferring to Erpi in 1928. He has been division operating manager with offices in Kansas City and New York. Sheridan, formerly with Bell Labs., joined Erpi in 1927. He has served in both the foreign and domestic divisions of Erpi.

25th Birthday For L. U. 253; N. Y. State Assoc. Meeting

Local 253, Rochester, N. Y., will observe its 25th Anniversary with a banquet at the Hotel Sagamore. L. U. 253 was organized June 12, 1912, the original charter bearing the names of 15 members. Present membership is 78, with Calvin Bornkessel president. Committee in charge of affair is Louis Levin, chairman; L. Goler, F. Hart, L. Townsend, L. Barager, C. Mason, F. Boekhout, and L. Burton.

The annual convention of the N. Y. State Association of Projectionists will be held in Rochester, N. Y., on June 15, coinciding with L. U. 253's 25th anniversary party. There are now 38 locals affiliated with the Association, which has compiled a unique record of accomplishment during the past several years. Claude Watkins, of Albany, is president, and the secretary is H. M. Brooks, of Troy.

Television "Projector Gun" Blows Up Images 2,600 Times

A new television "projector gun," which enlarges images a few inches in sizes to 8 x 10 feet, or 2,600 times the original size, on a large screen was demonstrated in N. Y. recently before the Institute of Radio Engineers.

When projected on a screen 3 x 4 feet, the brightness of the view approximated closely the brilliance of the average home movie. When enlarged to 8 x 10, the view, which was the head

of a girl, was clear to persons nearly 100 feet away from the screen.

The electron projection gun was demonstrated in the ballroom of the Hotel Pennsylvania, which is as large as many small motion picture theatres. To observers who wandered about the room, the image was clear from many angles and from the extreme rear of the room. The picture was of a greenish hue, but the contrasts were such as to evoke loud praise from the radio men.

Early Stage of Development

Dr. R. R. Law, who discussed and demonstrated the device, which he called a "high current electron gun for projection kinescopes," emphasized that the "gun" was in the early stages of its development. It is far from the form in which it may later appear as an integral part of a television receiver for the home or theatre, he said. The apparatus is quite formidable in its present form, and somewhat larger than the average theatre motion-picture projector.

Dr. Law said it was "yet too early to say if this is the 'gun' which will be used in the final television projection machine." He emphasized that the demonstration was not a radio or television display, but merely a laboratory test designed to show the projection properties of the equipment. The picture enlarged was 1.8 by 2.4 inches. No flicker was visible on the screen.

Speaking on the necessary brightness required for television scenes out of doors, Dr. Janes, of RCA, said new cathode-ray bulbs now under development in the laboratory were sensitive enough to pick up views "on very rainy days."

L. U., Film Board Meet

Film Board of Trade meetings in San Francisco are attended by representatives of L. U. 162 and many things of benefit to both groups are worked out. Such things as mutilation of film, misplaced change-over marks, print density, *etc.*, are referred to these meetings, with excellent results. Film exchanges are more than satisfied with the arrangement, as the Film Board is very anxious to continue the meetings.

S. F. apparently is the only city where the union and exchanges get together for such discussions, but the idea has great merit for every exchange center.

Studios and Electrics Set New Standards

Major studio sound department heads are meeting with sound equipment representatives under Academy auspices to discuss proposed new standards for sound track dimensions and placement on the film. With the increasing use of the push-pull method of recording and reproducing the sound directors are preparing standards in advance to which all new equipment may be manufactured, and to make certain that all recordings made on any type of push-pull equipment may be reproduced on all other equipments.

This method of preparing standards is in contrast to the old method whereby

each organization developed equipment independent of other units.

COLOR AND SOUND PROBLEMS FEATURE S.M.P.E. MEETING

(*Continued from page* 11)

reproducer came into widespread use. Commercial equipment for push-pull recording with ultraviolet radiation was installed in several production centers here and abroad. The use of non-slip printers was extended considerably as a further laboratory refinement.

In the 16-mm. field, new emulsions were made available for ordinary and color photography, and several new cameras and projectors were announced. *A gradual but definite invasion of the 35-mm. field was noted* as equipment for use in small auditoriums was being adopted. Such installations would probably not compete directly with 35-mm. equipment but would augment such equipment.

Summaries of the motion picture progress in Europe are appended to the report.

A NEW VIEWPOINT ON THE LIGHTING OF MOTION PICTURES

G. Gaudio

Hollywood

The lighting of motion pictures is discussed, with relation to a new technic developed by the author and employed in several recent productions, notably *Anthony Adverse* and *The Life of Emile Zola*. The use of artificial lighting for motion picture scenes originated with attempts to imitate the flat overall illumination produced by daylight on the early-day "daylight stages." When the concepts of modelling and effect lighting were introduced, they were regarded merely as adjuncts to an overall flat general lighting. They have, in the main, so continued until today, despite the great advances made by optics and sensitive materials.

The author holds that under modern conditions, this technic is faulty. He has therefore dispensed with the so-called "general lighting," and has for some time done all his lighting with various types of spotlighting units. This enables him to light more precisely; to accommodate his effects and his equipment to the physical requirements of modern production technic, and to achieve more natural effects upon the screen.

NEW AGFACOLOR PROCESS

Agfa Ansco Staff

Agfa Ansco Corp.

A survey of the history of monopack or multilayer photographic color processes is given, including the coloring methods of greatest importance at the present time. These are: (*a*) silver dye-bleaching methods and (*b*) silver dye-coupling methods. Silver dye-coupling methods appear to be most promising, and have been successfully applied to monopack films according to two distinct principles. In one method, color-forming compounds are added to the developing solutions. Color separation in this

method, depends upon control of the speed at which bleaching solutions penetrate superposed emulsion layers.

In the second method, employed in the new Agfacolor process, the different color-forming substances, instead of being added to the developing solution, are incorporated in emulsions that are coated in superposition so that three differently colored images are simultaneously formed in a single development. The metallic silver is subsequently removed by solvents leaving only pure dye images.

This new process is based upon the pioneer work on color-forming methods of R. Fischer who, before the World War, developed the process substantially as it is now being used. The contributions made by Agfa in improving this process are the perfection of dyestuff coupling components better than those available to Fischer, improved methods of preventing diffusion of the color-forming compounds, and methods of precisely controlling the manufacture of multilayer film upon a large scale, so that the present film is the practical expression in commercial form of Fischer's process.

RECENT DEVELOPMENTS IN MOTION PICTURE SET LIGHTING

E. C. Richardson

Mole-Richardson, Inc., Hollywood, Calif.

The basic principles of motion picture set lighting are outlined and the technic of "key" lighting, employed by most cinematographers, is discussed. Several new types of lamps that have found extensive use are described in detail. Technical data regarding them are presented along with information regarding their application in cinematography.

COLOR COMMITTEE REPORT

J. A. Ball, *Chairman*

The Eastman perforation, although adopted by the Society as a standard for positive and negative film, has certain disadvantages for use in connection with color processes and for background projection. The reasons for these limitations are analyzed, and a proposal is made that the important advantages of the Eastman filleted rectangular shape be retained in a perforation the dimensions of which are the same as those of the Bell & Howell perforation. Such a perforation would fit existing Bell & Howell registering pins.

The use of a photocell having most of its sensitivity outside the visible spectral region imposes an added burden to those working upon color-sound processes. Search is urged for a cell that would have all the advantages of existing caesium cells but with its chief sensitive response in the visible range.

The term "Direct Color Developer Process" is recommended for a color process wherein non-diffusing color-formers in the emulsion (multiple-layer) combine with the oxidation products of the developer to form insoluble dyes. A process of this type was introduced recently by Agfa.

THE EVOLUTION OF SPECIAL-EFFECTS PHOTOGRAPHY FROM AN ENGINEERING VIEWPOINT

F. W. Jackman

The development, and particularly the present status, of special-effects photography is discussed. In the early days, special-effects photography, or "trick camerawork," as it was called then, was not only mechanically crude, but was treated virtually as a matter of "black magic." The desired

effects, though were achieved more frequently by luck than by skilled intent, were almost invariably held as the closest of trade secrets—or more correctly, as personal secrets of the cameraman.

With the general advancement of the business and of the individuals therein, this condition has vanished to a large extent. Today there are definite, well-established classifications of this type of photography, governed by laws as positive as those covering any other branch of engineering. In building a bridge, for instance, the structural engineer knows that if a given load is to be carried, the supporting members must be of certain specifications. In the same way, the special-effects photographic engineer knows that if a certain effect is to be had, the components of his shot must be properly coordinated. In a miniature, a known scale in the model, combined with equally known factors of lens, camera-speed, *etc.*, will combine to produce a natural effect, while any deviation from any of these will appear artificial. The same holds true of the background production composite process, optical printing, and the like. In a word, the modern special-effects cinematographer who succeeds is the one who tackles his problems from an engineering, rather than a wonder-working, point of view.

ADVANCED TECHNIC OF TECHNICOLOR LIGHTING

C. W. Handley

National Carbon Company

Within the past several months the technic of lighting Technicolor motion pictures has changed from more or less flat, evenly illuminated sets of high light level to a method whereby the cinematographer now uses a much lower level of general illumination and has greater freedom with the use of "modelling" lamps.

Recent developments in arc lamps for use in Technicolor lighting are discussed. The changed technic of lighting, made possible by the new equipment and the laboratory advancements, is briefly explained. The uses of each type of illuminant, diffusion screens, black screens, and other lighting-control devices are described. An explanation is given of the part taken by the chief set electrician, or "gaffer," in lighting motion picture sets.

REPORT OF THE PROJECTION PRACTICE COMMITTEE

Harry Rubin, *Chairman*

Among the projects under consideration by the Committee during the past six months are those of screen brightness; its desirable values and methods of measuring it; the question of using a visual test-pattern for checking screen illumination; revisions of the standard projection room plans; questions of projector motors and take-ups, and difficulties incident to the starting of projector motors; requirements of sound screens; and a recently initiated survey of theatres throughout the United States to determine not only existing conditions of projection, but also for the purpose of establishing a set of recommendations regarding theatre structures.

SOUND TRACK BLOOPING

F. D. Williams

A demonstration of the various methods of blooping sound-track films, with special emphasis on the "flash" method. A series of drawings and film exhibits will be used to show a direct comparison of the methods and explain the value and qualities of each system of blooping.

THE SUPER SIMPLEX PEDESTAL

J. Frank, Jr.

International Projector Corporation

The new Super Simplex pedestal embodies a number of unique features, including spirit-level; lamp house table, with universal joints permitting accurate adjustment; sufficient mass to assure steadiness of the projected picture; support arms for various makes and types of sound head attachments; spacers to permit the use of existing port holes; and a lateral adjustment device.

A NEW FILM MUTILATOR

O. F. Neu

Neumade Products Corporation

To circumvent the film pirate who for years has been exhibiting film productions in various parts of the world without properly compensating the producers, a film mutilator has been developed.

The Neumade film mutilator housing is constructed of cast iron; steel rippers in an aluminum mutilating jaw perforate the film as it passes through brass film-guides and rollers. Each frame is perforated, completely destroying the pictures and sound-track, making it absolutely impossible to reprint, duplicate, or exhibit the film. There are two models having four types of perforations: single perforation in frame; double-staggered perforations in frame;

double perforations, one in frame, the other in sound-track; triple perforation, double-staggered in frame, the other in sound track. One model is hand-driven, the other motor-driven. The film is fed automatically into a slot in the left side of the housing, passes over the mutilator hub and perforators, and out through a slot on the other side.

A NEW INSTRUMENT FOR OBTAINING AUTOMATICALLY A GRAPHIC RECORD OF AUDIO - FREQUENCY CHARACTERISTICS

A. D. MacLeod

Tobe Deutschmann Corp.

The requirements of the acoustical engineering profession for a practical tool to be employed in analysis of audio-frequency characteristics of such electro-acoustic devices as microphones, audio transformers, loud speakers, and amplifiers, and in the determination of sound pressure *vs.* frequency as affected by baffle and cabinet design, are met by the newly developed Tobe Audi-O-Graph. This instrument incorporates the following features, which have been found essential for a usable tool: (1) It is entirely self-contained; (2) is reasonably portable; (3) covers an adequate frequency range; (4) produces a permanent record; (5) is fully automatic; (6) is provided with a means for rapidly checking the whole or any portion of the record; (7) its recording characteristics are essentially the same as those that have been adopted as standard for acoustical measurement.

The construction, operating principle, and practical application of the instrument are discussed in detail.

CHANGING ASPECTS OF THE FILM STORAGE PROBLEM

J. G. Bradley

National Archives, Washington, D. C.

Photographic film records are taking on new values. Business concerns, libraries, government agencies, and private collectors are beginning to realize the future value of photographic records. The hope that such records may be preserved over a long period of time has given impetus to storage plans, both in terms of chemical preservation and fire prevention. Volume to be stored is increasing rapidly. Federal Government's interest in aerial photography has resulted in an undreamed of volume of aerial film maps and additional government agencies making use of motion pictures. The volume in government circles alone will shortly exceed one hundred tons. The principle of unit isolation and unit application of cooling agent seems most logical in the prevention of film fires.

REPORT OF THE NON-THEATRICAL EQUIPMENT COMMITTEE

R. F. Mitchell, *Chairman*

A summary is presented of correspondence conducted with the British Institute of Cinematography. The report of this organization is abstracted as follows: (1) A theoretical analysis of the light losses in a projector using direct illumination is made, showing that for every 100 lumens emitted by the lamp, only 2.43 lumens find their way through the projection lens; and (2) it is suggested that unit intensity be used as a method of comparison between one projector and another and that 1 foot-candle be regarded as an average value for home use and 4 foot-candle for small auditoriums.

Objection is taken by this Committee to the latter proposal, and the opinion is expressed that the suggested values are too low. A satisfactory intensity should cover projection of adequate quality. Attention of the Society is directed to the matter of standardizing the procedure for the determination of total screen lumens.

COMPLETE CUE-MARK ELIMINATION PLUS AN AUTOMATIC CHANGE-OVER

S. A. McLeod

Automatic Change-Over Company

The vexing problem of cue-marking, both by producers and projectionists, is well known to all. Defaced cue-marked films have not only been costly and troublesome, but, most important, have resulted in poor picture presentation. Elimination of all cue-marks or any need of them, plus an automatic, electric transfer to the oncoming projector is now possible through the use of an automatic change-over mechanism which automatically performs the following operations: (1) gives a buzzer warning; (2) starts the oncoming motor; (3) changes over the dowsers; (4) changes over the sound.

Two trigger fingers or levers attached by means of a side plate to the reel, set by

the projectionist between the film windings, predetermine the timing. The unwinding film, releasing each finger, causes an impulse to be carried mechanically by means of pawls to two half-round plunger shafts in the magazine's hollow axle or spindle shaft. This spindle supports at its outer end a switch housing, enclosing two mercury switches. The mechanical impulse by means of the plunger shafts is here covered into an electrical impulse.

These electrical impulses are then carried to a main control cabinet mounted upon the wall between the projectors, conveniently accessible to the projectionist, and embodying automatic electric interlocks, relays, solenoids, and features for controlling the operations. The regular controls remain unaltered, allowing a return to the old "manual or visual" controls if desired. The entire unit may be adapted to all present makes of standard projection equipment, and the film trigger plates may be quickly attached to standard reels.

PRESENT ASPECTS OF THE DEVELOPMENT OF 16-MM. SOUND

A. Shapiro

The Ampro Corporation

A review of recent developments in 16-mm. sound, including technical advancements and perfections contributing to raising the standards of illumination and quality, and a discussion of the extent to which limitations of picture size and audience have been raised for large-audience performances. Adoption of the 16-mm. sound-film for educational purposes is discussed. Its function as a medium for auditorium instruction for general education of an extra-curricular nature and its use in the classroom as a corrolary to textbook and oral instruction are treated. The use of sound-films for unusual or difficult experimentation is not practical in the ordinary school.

There has been an increasing use of 16-mm. sound for commercial and industrial purposes. An example is the extensive use made of such films by automobile manufacturers for sales promotion. Picturizations of plant and manufacturing processes have been used as convincing evidence of quality and precision manufacture. A gradual but slow increase of home users is noted. Rapid development of road-shows indicates a repetition of a cycle of the earlier history of the motion picture. Sources of entertainment film and features now available are outlined. Attitude of large producers towards supplying 16-mm. sound prints, and foreign sources of material are given.

The relationship between 35-mm. and 16-mm. branches of the industry is discussed. Where is the legitimate domain of 16-mm.? Limitation of both types of film, the most effective fields for each, and then encroachment of 16-mm. in the entertainment field, are brought out. The possible effect upon the general trend of type of entertainment pictures is indicated, and suggestions for the regulation of the 16-mm. industry are offered.

SOME LIGHTING PROBLEMS IN COLOR CINEMATOGRAPHY

T. T. Baker

Dufaycolor, Inc.

In an additive process of color photography it is generally conceded that the primaries used are blue-violet, green, and orange bands of the spectrum, which overlap

to some extent in the transmissions, and are not narrow and sharply divided. It is also well known that the latitude in exposure of a color-screen process is smaller as compared to that of black-and-white negative stock. Underexposures will frequently tend to excessive blue, and overexposures to some other predominant color, these effects being in some measure due to differences in the shapes of the foot and shoulder of the characteristic curves of an emulsion when exposed to light of the three spectral areas used. But overexposure will always result in a dilution of the colors. This is due to the invasion of each primary into its neighbor's territory. There is thus a color saturation latitude in the screen or matrix, as distinct from a true emulsion latitude.

This paper discusses a method of calculating the approximate range of light-intensities, that can be used in studio lighting while maintaining the most correct color balance of which any particular additive color process may be capable.

RCA TELEVISION DEVELOPMENTS

R. R. Beal

Radio Corporation of America

A brief review is given of the studies made of the several characteristics of television images and other factors that have been effective in establishing standards, in determining satisfactory performance, and in guiding the step-by-step development of the RCA electronic system of high-definition television.

The system employs the "Iconoscope," a cathode-ray tube for translating the visual image into electrical impulses, and the "Kinescope" for transforming the electrical impulses back into the variations of light-intensity to reproduce the image. The sensitivity and characteristics of the "Iconoscope" as a pick-up device are discussed.

The fundamentals of the RCA high-definition television system now under experimental field test in the New York area and the standards presently employed are reviewed. Photographs of the studios and other parts of the field-test facilities are included. A brief review is given to indicate the progress made and the results attained up to the present time in these tests.

The technic of formulating and presenting television programs is peculiar to the requirements of television. The development of the technic is presently related to programs employing artists in studios, outside pick-ups, and motion picture film. The requirements of program technic are discussed.

NEW MASS. RULES PROVIDE MODEL WORK CONDITIONS

(*Continued from page* 11)

strove to attain their goal, and upon the vision and social-mindedness of the Mass. authorities who, seeing the right, courageously backed up their decision and approved these regulations. Code highlights are appended hereto:

No cinematograph or similar apparatus involving the use of a combustible film more than ten inches in length, except one using only an enclosed incandescent lamp and cellulose acetate films not more than one and one quarter inches in width, shall, except as provided by Sections 85 and 86 (portable and non-theatrical) be kept or used for the purpose of exhibiting such films in or upon the premises of a public building until such cinematograph or simi-

lar apparatus has been inspected and approved by an inspector, who shall have placed thereon a numbered metal tag; nor until a booth or enclosure, which has been inspected and approved by such an inspector and his certificate issued therefor, has been provided for said apparatus; nor until such precautions against fire as the Commissioner of Public Safety may specify have been taken by the owner, user or exhibitor; provided, that no such apparatus shall be operated with oxyhydrogen gas, so called, or with limelight.

In addition, in Boston the location of any booth or enclosure surrounding such apparatus shall be approved by the building commissioner, who may order such additional precautions against fire as he may deem necessary.

Ample Ventilation, Room Temperature

The inspectors shall inspect any such apparatus which is to be kept or used as specified in the preceding section, and any booth or enclosure provided therefor, and the commissioner of public safety shall make such rules and regulations as he may deem necessary for the safe use thereof.

The projection room shall be provided with mechanical ventilation by means of a fan of sufficient size to remove at least one thousand (1000) cubic feet of air per minute.

An opening shall be provided near the center of the ceiling or at its highest point to be not less than eighteen (18) inches in diameter or two hundred fifty (250) square inches in area, to the upper side of which shall be fitted an iron flange securely fastened to the ceiling. To this flange an eighteen (18) inch vent duct shall be securely fastened made of not less than #26 gauge galvanized sheet metal which shall lead to the outside of the building or to an incombustible vent flue of equal or greater area running vertically and carried at least three (3) feet above the roof line.

An approved electric exhaust fan, controlled from within the projection room by a switch located near the entrance door, shall be installed as directed by the inspector, within this duct, the operating motor and wires of which shall be entirely encased in metal.

There shall be provided in this room near the floor level a fresh air supply by means of a galvanized sheet metal duct having an area of not less than three and one half (3½) square feet, (28" x 18"). This duct shall be connected to the outside air, be pitched downward, and shall be provided with a regulating damper. The outside end shall be provided with a hood arranged so as to keep out the weather and the inside end provided with a register face or ¼" mesh screen.

Sufficient radiation shall be installed to keep this room at normal temperature. If radiators or steam coils are used they shall be protected with ¼" mesh wire screening, and the upper sides if not recessed shall be sloped at a sharp angle so that they cannot be used as shelves.

A toilet room with approved toilet facilities shall be connected with the projection room.

The above auxiliary rooms shall be of like construction as the enclosure and shall have the same height.

The projection room of a booth or enclosure shall be not less than 12 feet in length, 10 feet in depth, and 8 feet 6 inches in height (inside dimensions) for two moving picture machines, and shall be increased 4' in length for each additional machine, spotlight, or effect machine.

All booths or enclosures of new construction in theatres and moving picture halls shall be built strictly in accordance with these regulations. All existing booths or enclosures as suitable opportunity is afforded shall be altered so as to conform as nearly as is reasonably possible to these regulations.

Film Inspection, Projectionist Negligence

It shall be the duty of the operator to make a thorough examination of all films before each exhibition. Film that shows exececssive wear or deterioration, faulty patches, torn sprocket holes or other imperfections shall not be run.

If an inspector finds that an operator is negligent, or conducts himself or keeps his equipment in such a way as to cause it to be a menace to the safety of the audience, or violates any of the rules and regulations herein contained, he shall suspend or revoke the license of the operator and forward the same to the Chief of Inspections with a written report. Should an operator whose license has been suspended or revoked desire to appeal to the Chief of Inspections from the decision of the inspector, he shall forward with his request for a hearing a written statement of his version of the circumstances.

While projecting a picture the operator shall devote his entire time and attention to that work, and shall not leave the operating side of the machine. "Pickups" so called, are prohibited when only one licensed operator is employed in a booth.

Projectors shall be kept clean, in good mechanical condition, and free from waste oil.

Portable Booth Ventilation

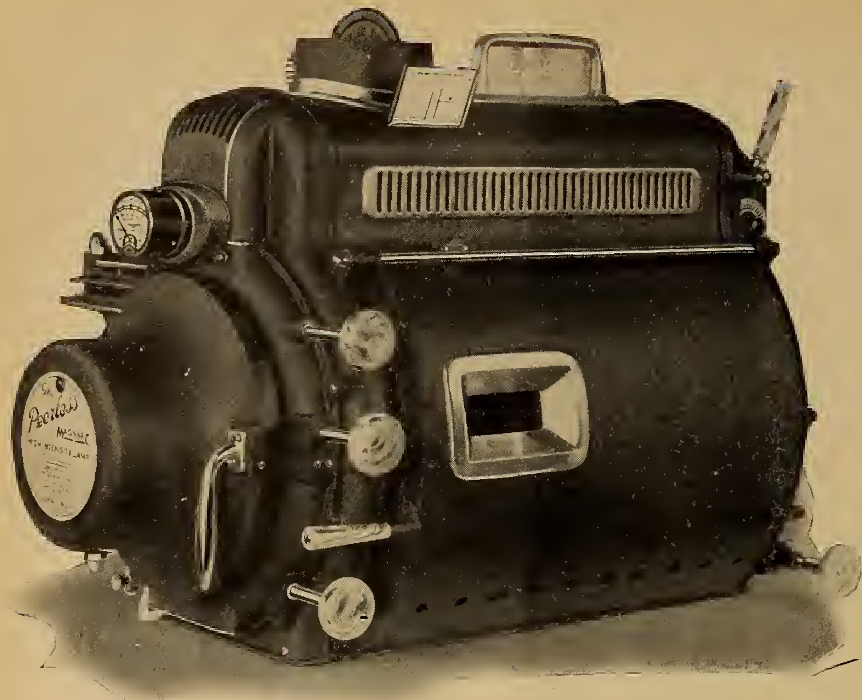
For ventilation the booth shall be provided with an inlet, in each of the four sides, ten inches in width and two inches in height. Such inlet shall be covered by a wire netting of not more than one-quarter inch mesh, the lower side shall be not more than two and one-half (2½) inches above the floor. The netting shall be firmly secured to the walls of the booth by means of metal strips and bolts.

Ip

International PROJECTIONIST

JUNE 1937 Vol. 12, No. 6

25c Copy $2 a year



Peerless

MAGNARC

TRADE-MARK REG.

THE "ALADDINS LAMP" OF PROJECTION

Peerless Magnarcs are daily performing veritable miracles by their ability to increase screen illumination, improve projection and by the amazing economies their installation afford.

Nothing comparable to the Magnarc exists. The overwhelming plurality of Magnarc Lamps in use is the natural result of its vast superiority.

It's the "NUMBER ONE" lamp of the industry and it shares its quality, value and results with none!

Made by the largest manufacturer of projector arc lamps in the world and sold by the greatest equipment sales organization in the nation, your investment is doubly protected.

WHY HAVE LESS?

SOLD BY

NATIONAL THEATRE SUPPLY CO.

MANUFACTURED BY

J. E. McAULEY MFG. CO.

552-554 WEST ADAMS ST. **CHICAGO, ILLINOIS, U. S. A.**

International
PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 12 JUNE 1937 *Number 6*

Published Monthly by

JAMES J. FINN PUBLISHING CORPORATION

580 FIFTH AVENUE, NEW YORK, N. Y.

Circulation Manager, RUTH ENTRACHT

SUBSCRIPTION REPRESENTATIVES

AUSTRALIA: McGills, 183 Elizabeth St., Melbourne
NEW ZEALAND: Te Aro Book Depot, Ltd., 64 Courtenay Place Wellington
ENGLAND AND DOMINIONS: Wm. Dawson & Sons, Ltd., Pilgrim St., London, E. C. 4.

YEARLY SUBSCRIPTION: United States and possessions, $2 (two years, $3); Canada and foreign countries, $2.50. Single copies, 25 cents. Changes of address should be submitted two weeks in advance of publication date to insure receipt of current issue. Entered as second-class matter February 8, 1932, at the Post Office at New York, N. Y. under the act of March 3, 1879.

MONTHLY CHAT

RECENTLY we published an article which detailed the tremendous development of the 16 mm. projector field and cited the job-creating possibilities inherent in such an advance. Projectionist unfamiliarity with other than 35 mm. equipments puts the task of supplying such information squarely up to us. The first of a series of such articles will appear in an early issue—probably the next.

LEGISLATIVE forays by units of the organized craft have been almost uniformly unsuccessful during the past year. The standard alibi for failure of such efforts is exhibitor "influence". Yet, both the city of St. Louis and the State of Massachusetts weigh in with two-men shifts riveted into the regulations. How come?

THIS surely is a great business. Film company sales managers, meeting at exhibitor conclaves, discuss among themselves increased film rentals. The net result of the independent dealers' recent meeting in Chicago seems to have been the formation of a *manufacturers'* association! We anticipate that managers will soon be attending union meetings to devise means for cutting wage scales.

EVEN casual inspection of the current report of the S.M.P.E. Projection Committee, published elsewhere herein, will show how far projection has advanced within the past decade. Frankly, complete understanding of this report requires a knowledge of the projection process that is not possessed by many who depend on projection work for their livelihoods.

It's easy enough to suggest that such reports be "written down" for popular consumption (as has so often been suggested to I. P. itself); but far more comforting would be the knowledge that practically the entire craft would be able to digest this data. For example, few people like mathmatics well enough to toy with the subject as a hobby, but the inescapable fact is that mathematics is a form of scientific shorthand. I. P.'s experience in trying to teach elementary mathematics through these pages is too painful to recall even at this late date—yet we doubt that we ever had a better idea of more potential practical value to the craft.

The solution to which vexing problem will have to await the appearance of one much smarter than ourselves. Or, maybe, just smart.

STAY away from the hammock these fine summer days. Get out in the open, breathe deeply, exercise often, and don't be afraid of a little direct sunlight on your carcass. All of which will help mightily to combat next winter's assault by sundry baccili and carbon dust.

INTERNATIONAL PROJECTIONIST

VOLUME XII NUMBER 6

JUNE 1937

TYPICAL TROUBLES IN MODERN SOUND REPRODUCING UNITS

By *LEROY CHADBOURNE*

HERE are a number of cases of actual sound troubles that could not have occurred with earlier types of apparatus. They are all based upon peculiarities of construction or design formerly not found in any theatre.

Case 1. Amplifier fuse blew, with sparking at output tube sockets. This trouble reappeared at irregular intervals, although new output tubes were inserted each time. Examination of the tubes showed flash-over from plate prong to ground. Tests of socket voltages made from time to time showed normal readings.

Further tests involved forcing high volume through the amplifier, which broke down several more sets of output tubes at shorter but still irregular intervals. Inspection of the circuit diagram showed that the amplifier had no coupling transformers except the output transformer. The water-pipe ground was inspected at once, and found to be in poor condition. This fact, together with the absence of coupling transformers, indicated the probable cause of the trouble, which was permanently cured by cleaning and tightening the ground connection.

In this case there are two basic differences between the apparatus involved and earlier types of theatre equipment. One, as stated, is the absence of coupling transformers. In earlier equipments these were common for two reasons: first, the amplifying system was often divided into a number of separate amplifier units, which were most conveniently coupled by means of input and output transformers; second, early tubes were of the low-gain type and transformers could be made to contribute some degree of voltage amplification.

Oscillation Inducing Distortion

Today the amplifier is usually a single unit, and high-gain tubes are favored. Modern circuits have made it unnecessary to include a transformer even at the point of transition from single-end to push-pull amplification. (Diagrams of modern amplifiers that use no interstage coupling transformers will be found in I. P. for Aug., 1936, p. 13; Oct., 1936, p. 15, and Nov., 1936, p. 21.)

The absence of coupling transformers, with their inherent frequency limitations, makes it easier for the amplifier to oscillate at super-audible frequencies. Such oscillation can be heard as distortion in the sound, but is not otherwise audible. It has the electrical effect of building up high oscillatory voltages at the plates of the tubes. In the case of trouble just described these voltages were breaking across at the sockets of the output tubes and so overloading the main fuse.

One precaution against such oscillation is grounding the amplifier to earth. The poor ground reported in this case undoubtedly was open-circuiting at times when the water pipe was subjected to vibration. Whenever this happened it became possible for the amplifier to oscillate. Tightening the ground connection cured the trouble completely.

Super-audible oscillation is a trouble very common in modern amplifiers that do not use coupling transformers. It is also encountered in those that use coupling transformers of the modern kind which have a frequency range far beyond that of the loud speakers. This possibility is part of the price that must be paid for

the modern advantages of compactness, lower cost, and extended frequency reproduction.

Adequate grounding of the amplifier chasis *and of its speech input cables* is the precaution most important to the projectionist. Others consist of decoupling condensers and resistors built into the circuit (see I.P. for Nov., 1936, p. 20) which should be checked in cases of oscillation not cured by proper grounding.

A second basic difference between the apparatus involved here and earlier amplifier types lies in the construction of the tubes. Tubes are smaller, base prongs are more closely crowded. In this case, the tubes were metal, and the high-voltage plate lead was insulated from the grounded shell only by a small glass eyelet. This eyelet punctured when oscillation built up momentarily excessive voltages. If an amplifier of earlier type had been able to oscillate in the same way, the only objectionable effect would have been distortion. The more generous insulation of the tube prongs would never have given way.

The sensitivity of modern tubes to excessive plate voltage lies at the bottom of another case of trouble presenting similar symptoms.

Ground to the Chassis

Case 2. Oscillation was not involved in a similar instance of repeated breakdown of output tubes (also accompanied, of course, by outage of the amplifier fuse). Plate voltage readings were consistently high. Tube breakdown occurred at high volume levels. Finding the cause of this trouble obviously meant finding the cause of the high voltage.

A check-up showed no evidence of a short-circuited resistance or choke in the plate circuit. To the contrary, voltage dropped regularly and naturally from the plate secondary of the power transformer to the sockets of the amplifying tubes. A rush request was sent to the manufacturer for data as to proper voltages at the transformer secondary.

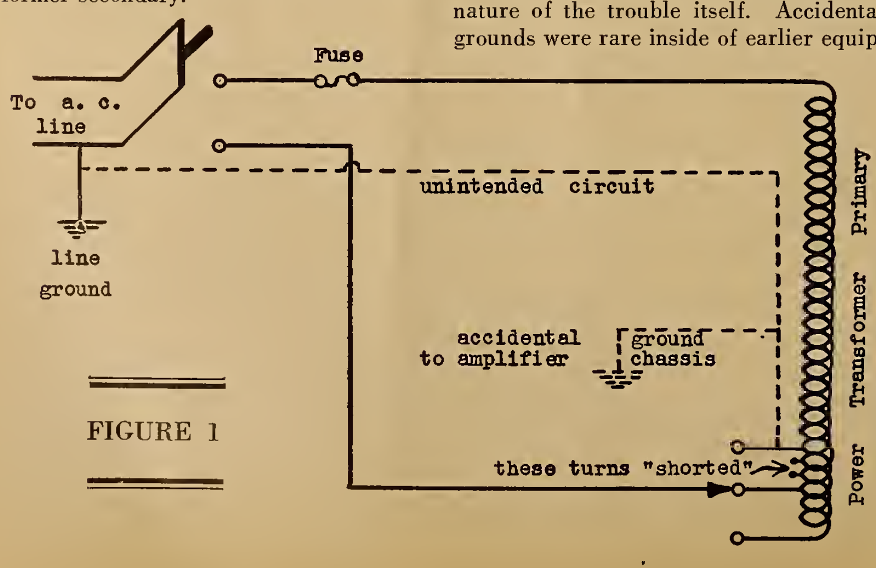


FIGURE 1

Before the reply came, it was noted that heater voltages were also high. In the case of the heaters the difference was only a fraction of a volt, but it was proportionate to the increase in plate voltage. This fact at once suggested inspection of the circuits of the power transformer primary.

Several primary taps had been provided to compensate for differences in line voltage. It was found that one of the unused taps had grounded to the amplifier chassis. Since the a.c. supply line was also grounded, the effect (see Fig. 1) was to reduce the number of primary turns, thereby increasing secondary voltage. Clearing the accidental ground ended the trouble.

Modern Tubes Very Sensitive

This instance again illustrates the sensitivity of some modern tubes to relatively small increases of voltage. Many early amplifiers, not having tapped power transformers or equivalent arrangements, were injured by local power lines. Overheating through long periods of time baked the insulation from their wires, boiled asphaltum out of their condensers, shortened the lives of their tubes and sometimes blew out their power transformers. But arcing over at the tube base was unheard of.

[Earlier types of tubes sometimes arced over internally from the same cause, although the mechanism was different. Overheating of the filaments weakened the tension of the springs that kept the heated filaments taut, and excessive plate voltage overcame the pull of the weakened springs, causing the filament to sag sideways until it touched the grid. That shorted out the grid bias and permitted a flow of plate current heavy enough to wreck the power transformer. This is a type of trouble to which the newer tubes, having heater cathodes that cannot sag, are immune.]

A more striking departure from former methods of construction is shown by the nature of the trouble itself. Accidental grounds were rare inside of earlier equipments, which were built more carefully and more spaciously than present practice allows. Still a better example of the effect of this difference in physical layout is afforded by the following case.

Case 3. Symptoms: sudden conspicuous decrease in volume which (the amplifier being rather small for the house) could not be brought back to proper value even by setting the volume control to maximum.

This trouble was easily found by a socket voltage check. Plate voltage of only one tube read high. In this tube, a pentode, the screen-grid voltage was also high, and screen grid and plate readings were identical. These results indicated that the plate had "shorted" to the screen grid, and that the tube was acting as a triode rather than as a pentode with a corresponding reduction in voltage gain.

The arrangement of the tube prongs was such that a "short" at the socket itself was unlikely, so circuit wiring was inspected. A bakelite plate on the under side of the chassis held a dozen or so resistors mounted side by side. The plate series resistor and the screen-grid resistor of the tube in question were mounted adjacent to each other. The power ends of these two resistors were commoned, since both drew "B" voltage from a common source. The tube ends were also found joined, through a single thread of stranded wire which had in some way come loose from a soldered connection and moved less than ¼ inch. Natural volume was restored by snipping off this strand and re-soldering the connection from which it came.

Accurate Meters Essential

Case 4. Another and similar trouble arising out of modern construction consisted of sharp distortion, particularly noticeable at high volume. In this case an inaccurate meter showed no important departures from proper plate voltages. Substituting new tubes failed to help. Ultimately, plate *current* readings were taken, and one tube read high. This indicated a possibility of low grid bias, which had not been checked because of meter inaccuracy. Inspection of the grid bias circuit revealed the trouble:

Two grid bias "cells", each supplying one tube, were clipped in place along a small "cell strip". The arrangement approximates that at a flashlight bulb base. One side of the circuit connects to the body or shell of the bias cell, and the other side to a metal point set in the center of a ring of insulating material. A spring clip, touching the point, presses the body of the cell to the grounded strip. Through vibration or otherwise either the cell or the clip had slipped, and the clip was bridging across the insulating ring, "shorting" the cell completely.

Case 5. Still another group of

Old Faithful Geyser, nature's headliner in Yellowstone National Park, puts on a four-minute show and repeats it exactly every 67 minutes. It has been doing this for at least 100 years. During its brief act this miracle of nature hurls more than 200,000 gallons of boiling water into the sky for a distance of over 150 feet.

MIRACLES DON'T "JUST HAPPEN"

. Nature spent centuries on the process of creating the miracle of Old Faithful.

E.R.P.I. spent years in the commercial adaptation of a revolutionary principle of sound reproduction known as MIRROPHONIC. Like Old Faithful, MIRROPHONIC is a product of time—it is a result of long research by Bell Telephone Laboratories and Western Electric in perfecting a reproducing system first conceived in the form of Stereophonic or "third-dimensional" sound.

MIRROPHONIC is the direct commercial outgrowth of the historic Stereophonic principle—first publicly demonstrated four years ago in Philadelphia, later in New York, Hollywood, and recently, in Miami.

MIRROPHONIC is readily adaptable to future advances in the art. If you now have Western Electric, it may be installed on a convenient step-by-step modification plan.

More than a thousand exhibitors, who have installed MIRROPHONIC, used its powerful exploitation campaign, now enjoy increased BOX OFFICE DOLLARS.

Old Faithful and MIRROPHONIC never fail to come through with a *good* show *on time*—and with

"A THRILL FOR YOUR EARS!"

THE NEW
Western Electric
MIRROPHONIC
SOUND SYSTEM

THE STANDARD OF THE WORLD

Only MOTIOGRAPH'S PEDESTAL Gives You These *FEATURES!*

The Motiograph pedestal is made of cast iron and has a weight of 415 lbs. evenly distributed over a floor area of 22" x 30¼". The low center of gravity and concentrated weight provides the rigidity and strength necessary to support the heavier modern projector, sound head and lamphouse. For a sound reproducer requiring an offside mounting of the motor, a "T" slotted motor table support is available. Provision is made on the main frame for mounting this table, and the assembly gives every necessary adjustment for different angles of projection. Built into the pedestal are many exclusive features, illustrated to the right, the entire assembly being finished in a popular wrinkle grey baked enamel.

LAMPHOUSE CARRIAGE

For horizontal optical alignment, the lamphouse carriage slides from side to side on two heavy rods within the body of the main frame.

VERTICAL OPTICAL ALIGNMENT

Motiograph's movable union block permits perfect coincidence of the mirror and lens axes, thus assuring perfect optical alignment. Micrometric adjustment is possible by a simple turn of the cap screw, and the proper setting is rigidly locked with four cap screws.

TILTING DEVICE

Within the base of the pedestal is a ball-bearing tilting device which permits the projector to be tilted to any angle and locked—a one-handed, easy operation. The complete wiring for the projector is centralized within the pedestal.

BUILT-IN SWITCH

The 100-ampere, double-pole, single-throw arc switch is built into one of the compartments of the projector base. A hinged door provides easy accessibility.

BASE COMPARTMENTS

There are two compartments in the base, one for tools and one of 12-inch depth, for carbons.

FOUR CORNER LEVELING SCREWS

Newly designed leveling screws seated in sturdy floor cups provide absolute floor contact and permit exact and easy leveling of the image on the screen.

MOTIOGRAPH

THE WORLD'S FINEST PROJECTOR DESIGNED FOR ALL STANDARD SOUND EQUIPMENT

MOTIOGRAPH, INC. 4431 W. LAKE STREET, CHICAGO, ILLINOIS

troubles arises out of the current practice of interlinking what are nominally entirely separate pieces of apparatus.

A theatre system used two amplifiers, regular and emergency. A multiple-pole changeover switch connected either, at will, with the photocells and loudspeakers. A subsidiary link existed in that the photocells drew their bias voltage from the amplifier power circuits. The "regular-emergency" switching of p.e.c. voltage was not tied in with the sound switch, hence when the system operated through the regular amplifier, p.e.c. voltage might sometimes be drawn from the emergency unit, or *vice versa.*

In this system a 120-cycle hum was heard on the regular amplifier only. Tubes being suspect, the regular and emergency sets of tubes were interchanged. This made no differencc, and tubes were eliminated as a cause of the trouble. More intensive investigation through several days proved fruitless, but emphasized the incidental fact that all tubes in both amplifiers, were old and weak. A set of new ones installed in the regular unit unexpectedly ended the hum.

The explanation was found in the separate switching arrangement for p.e.c. voltage supply which had been overlooked when the regular and emergency tubes were interchanged. Apparently both sets of tubes were weak enough to cause p.e.c. hum when they had to supply the cells and the amplifier simultaneously, although harmless when one set supplied the cells and another set the amplifier.

This form of secondary interdependence of apparatus, formerly unheard of and now very common, not only causes troubles formerly impossible but makes some early methods of checking trouble inappropriate. Had the p.e.c. supply been independent of the amplifier power circuits, a hum in one amplifier only, if not cured by interchanging tubes, could not possibly have been caused by tubes. Secondary linkages grow more common with increasing concentration of sound equipment. They *must* be considered in checking for trouble of all kinds.

Inter-Linkage Requires Attention

Case 6. A dramatic result of forgetting such linkage was experienced with very modern apparatus when the monitor speaker developed a rattle. An attempt was made to install a replacement speaker during the show, apparently on the theory that the show could run ten minutes without a monitor. Doubtless it could, normally, but the monitor in this ultra-modern system happened to derive its field excitation from the amplifier "B" circuit, in which its field winding served as an external filter choke. During replacement, when the first wire was removed from the monitor field there was a flashover, a raucous noise from the stage speakers, and sound went dead. Fortunately, the filter pack withstood the inductive kick, and sound was restored as soon as the rattled replacement artist recovered his wits. With systems of different design, replacing a monitor unit during the show is a matter of routine that causes no trouble at all.

Case 7. In one sound system, product of an extremely well-known maker, sound went dead in the case of one projector, and the show was run on the other for 90 minutes—with, of course, "one minute please while the operator changes reels". No trouble was found at the projector. Exciter light and focus were okay, photocell voltage checked normal, and connecting cable was solidly connected and grounded.

This trouble lie in the fact that the sound system tied in with the p.a. system, the amplifier being equipped with the microphone jack (Fig. 2). The microphone substituted for No. 1 photocell. When it was plugged in, the voice line to that photocell opened automatically, although the voltage supply to the same cell remained intact. A bit of dirt had prevented the jack closing completely the last time the microphone plug was removed.

Cases 8 *and* 9. A rather wide variety of troubles with sound *quality* arises out of the newer methods of controlling frequency response. In one instance (a single-speaker system) sound became noticeably shrill and displeasing at unpredictable moments, at other times retaining its usual good quality. This seemed to indicate some intermittent change in contact somewhere in a frequency control circuit.

The amplifier had two entirely separate arrangements for controlling frequency. The second of these proved to be faulty. This was a switch arrangement connecting to a number of condensers, any or all of which could be shunted across a speech line or open-circuited, depending on the switch setting. At the time of installation most of these condensers had been switched into use, to give the best results according to the acoustics of the house. An intermittently poor contact at the shaft of the rotary switch periodically open-circuited all of the condensers, increasing the h.-f. response for the time being.

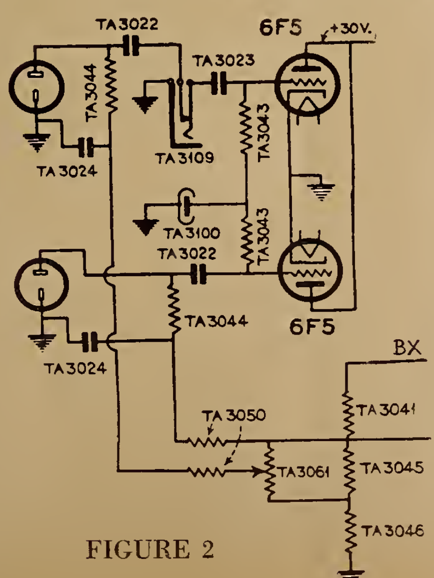


FIGURE 2

A more simple case of frequency trouble was encountered in a dual-speaker system in which sound suddenly lost all body and depth, and a considerable portion of its volume. An immediate check at the screen confirmed that the bass speakers were delivering practically no sound, and the trouble was quickly run down to outage of a fuse in the bass speaker field supply rectifier.

Common Modern Unit Troubles

These nine specific instances exemplify definite types of trouble either exclusive with or probable in modern sound systems. These trouble classifications may be repeated here as: tendency of many modern amplifiers to super-audible oscillation; sensitivity of many modern tubes to voltage overload; mechanical difficulties arising out of crowded construction; new forms of trouble and new difficulties in finding them, which arise out of secondary interlinkages of separate components of the system; frequency troubles —suppression or undue emphasis of a group of frequencies—which are intensified by modern methods of frequency control and distribution.

Some of these classifications represent temporary conditions, due to new design. The most modern amplifiers can be made wholly immune to oscillation. Some improvement has already been effected in making modern tubes less sensitive to excess voltage, and further developments along this line are under way.

Compact construction undoubtedly will remain. Most of the troubles it creates will be eliminated by more careful layout and sharper factory inspection. The handicap it presents in *tracing* trouble will be permanent, but is largely overcome by the availability of modern testing equipment. Modern space-economy and lower first cost of sound apparatus justifies the relatively small expense of a modern analyzer.

Secondary interdependence of sound components is also justified by considerations of economy and fundamental simplicity. It causes no more headache than the use of additional pieces of apparatus to perform the same functions, and presents no important difficulty in trouble shooting, once the new circuits are understood and *remembered.*

Frequency troubles is the price that must be paid for modern improvement in frequency response.

THE TERM "RMS" . . .

ITS MEANING AND APPLICATION

The appended article is an answer to numerous requests from the field for an explanation of the term "rms value" and is indicative of the worth to the craft of a responsive and inquiring reader audience. The answer was supplied by Dr. A. N. Goldsmith, consulting engineer of N. Y. City.

THE abbreviation "rms" stands for "root-mean-square". This, in turn is an abbreviation of the longer phrase: "The square root of the mean or average value of the squares of all the values of". This looks like rather a mouthfull, but it is really fairly simple, and it covers a necessary way of finding the useful or effective, value of alternating currents, voltages, or power.

Supposing we want to find out how much heat is produced in a conductor by an electric current. This is important in connection with incandescent lamps, the heat of electric machinery, the power in an electric arc, and similar heating effects of electricity. It is well known that the rate at which power is produced by a given electric current passing through a definite resistance is given by the relation that the power in watts equals the *square* of the current multiplied by the resistance.

As long as we deal with direct currents of constant value, the problem of heat effect is easy enough. For example, if a direct current of 5 amperes flows through a resistance of 4 ohms, the power absorption, or heating effect, is 5 squared (or 25) multiplied by 4, or 100 watts.

But suppose we deal with a current which is changing. For example, supposing the current starts at zero and increases steadily to 10 amperes, changing by the same amount every second. That is, it rises at a steady rate from zero to 10 amperes. The current has an average value of 5 amperes. At this point it is easy to be fooled and to assume that because the average value of the current in this case is 5 amperes, if such a current flows through a resistance of 4 ohms, it will require an electrical power of 100 watts, as before in the case of the direct current, and will also produce an amount of heat corresponding to 100 watts.

Average Power Calculation

The fallacy of such reasoning is easily shown. When the current is at zero, the power is also zero. When the current has risen to 5 amperes, the power is 100 watts. But when the current has risen to 10 amperes, its greatest value, the power has risen to the *square* of 10 (or 100) multiplied by 4, or 400 watts. Clearly the average or mean power in this case is *not* 100 watts.

In such cases of constantly changing currents, obviously we have to take three steps to find out what the average power is (or what constant current would generate the same amount of power). The three steps are the following:

Step 1. Square the value of each instantaneous current flowing during a given period. We shall call this the "squaring" process. It gives an indication of the instantaneous power required (through 1 ohm).

Step 2. Take the *mean*, or average, value of all the squared currents obtained in Step 1. This gives us the average or *mean* value of the squared currents or instantaneous powers through 1 ohm.

Step 3. Take the square *root* of the value of the average square obtained in Step 2. This gives us the square root of the mean, or average, value of all the squared currents (or instantaneous values of power through 1 ohm.)

And the result obtained from Step 3 is the quantity we have been seeking which shows what steady current, flowing through 1 ohm (or, indeed, any other resistance), would give the same heating or power effect as the actual changing current which we have considered.

If Step 3 is considered again, it will be seen that the new quantity which would have been calculated in this way is the square *root* of the *mean* value of the *square* of all the instantaneous current values during the period in question. And that is why it is called the "root-mean-square", or "rms" value.

While the foregoing describes the process of getting the "rms" value, the actual calculation is far from simple. It really requires fairly advanced mathematics to determine the rms value of currents or voltages varying in particular ways.

A Typical Application

Perhaps the best known example, and one which is of most importance to electricians, is the rms value of a true alternating current of the so-called "sine-wave" type. This is practically ordinary alternating current as obtained from the power mains or ordinary alternaters. In this case, if the alternating current goes from zero value to an instantaneous power of 10 amperes, and then back to zero, and then reverses to a negative peak of 10 amperes, and back to zero and so on, the rms value turns out to be 7.07 amperes.

This leads to two interesting comments. In the first place, any alternating-current ammeter placed in the circuit will read 7.07 amperes in this case, for it will be designed and calibrated to read rms values.

The second point is that the reversal of the alternating current half of the time does not change the heating effect. Heat is produced regardless of direction of flow of current. This is unfortunate, perhaps, because it might be easy otherwise to reverse a heating current and get refrigeration!

---

60 Types of Film Stock Added Within 25 Years

Twenty-five years ago there were but two types of motion picture film, negative and positive. In 1913, panchromatic film was supplied, and since then improvements and changes in emulsion, backings, tints, and the like have been introduced so that at the present time there are manufactured 62 different types of motion picture film, including 35 different types of nitrate film and 27 of safety film.

The problem of testing and controlling such a large variety of materials is a complicated one. In spite of the extreme care taken to keep each step in the preparation of each type of film entirely uniform, occasional variations creep in that are sometimes traced to extraordinarily insignificant causes. In order to check such variations, each department has its own testing facilities and laboratory, in which as many as possible of the qualities involved are tested. In addition, there is a general testing department, in which routine tests are made on all products, while occasional intensive studies are made by members of the research staff or other groups.

What, ask several correspondents has become of I. P.'s campaign for sound equipment servicing by the craft? We'll answer that question by answering another: What *did* become of it? One more editorial on craft servicing and we should have burst.

CIRCUITS' SWEEPING MODERNIZATION THREATENS INDEPENDENTS' STATUS

By *FRANK T. JAMEY, JR.*

STAFF WRITER FOR INTERNATIONAL PROJECTIONIST

Sweeping equipment modernization drives by all the major theatre circuits brings the independent theatre operator face to face with the necessity for doing likewise if he is to survive and compete with the circuits. These improvements include not only modern sound systems but also vastly improved visual projection apparatus. The projectionist, being the best informed person in any theatre on technological progress, has an important role to play in spreading the doctrine of equipment modernization.

DURING the past year a number of very interesting developments have taken place which will have a great effect in the near future upon the independent exhibitors throughout the U. S. These developments are in the field of sound-on-film recording and reproducing, although they will also affect other projection room apparatus.

Theoretically, it is desirable to install a sound reproducing system in each theatre in the country that has been custom-built for best results in that theatre. As a matter of fact, the same theory holds for both the radio and the phonograph in the home. However, it is not practical to do this, and particularly at a price commensurate with that which the average theatre owner can afford. The result has been that manufacturers of such apparatus have had to strike a happy medium. They have divided the theatres into a number of groups depending on size, seating capacity and cubical content, and have made available reproducing equipments which will adequately take care of the average theatre in each such group.

Many of these equipments are provided with controls of one sort or another which permit slight variation of the response characteristic after installation, depending on the acoustic conditions of the auditorium to insure intelligible speech.

When we consider that most of the theatres in this country were totally unprepared for sound motion pictures, as far as acoustics were concerned, in 1927-28, and that there were few people who really knew much about acoustics at that time, it is easy to see that any reproducing equipment which would, at not too great an expense, provide suitable entertainment would have to be a decided compromise with that theoretically desirable.

Another factor which has played a large part in this problem for the first seven or eight years of sound pictures has been the tremendous variations in recording characteristics. Naturally, the recording systems provided for the Hollywood producers in 1927-8 were none too good, and, furthermore, there were not many engineers who knew how to operate them properly. They were very complicated and critical. In addition, the problem of proper processing of film for best sound results was not considered. Even today it is true that in most studios there is no executive connected with the sound department that has enough authority to insist upon conditions favorable to high quality recording.

For several years now the manufacturers' laboratories in the East have had processes for recording and developing sound tracks that permit a quality of sound far better than that on any regular release print. One of the most important problems has been that each studio, and in some cases each recording engineer, has used a recording characteristic that he thinks is best. This characteristic has been affected by the film processing in the laboratories, and also has depended a great deal on the reproducing equipment used in studio preview room, which has been very much out of date.

On a number of fronts developments have been taking place which have already to a large extent overcome many of these barriers. In the first place, Douglas Shearer of the Metro-Goldwyn-Mayer Studios, one of the country's outstanding sound engineers, had the foresight to comprehend most of these difficulties and the courage to find a way to eliminate them. He was in the fortunate position of being associated with a company which controlled not only one of the largest and foremost producing studios but also an important circuit of key theatres, Loew's, Inc.

He realized that if he could arrive at a standard theatre reproducing equipment which could be installed in everyone of the 128 Loew's theatres in the country, and then decide on a recording characteristic which could be properly controlled during the re-recording and processing stages and would sound as he desired in any of these 128 theatres, he would be making a tremendous contribution to the industry. It was quite evident that if the combined facilities of Loew's, Inc., could accomplish this, the rest of the industry would undoubtedly follow suit.

The first step in this really tremendous program was to persuade leading manufacturers of sound reproducing equipment to make available apparatus which could be standardized and reproduce sound of the high quality which would make it a good investment to install. Mr. Shearer was able to accomplish this as a result of some experimental work carried on in his studios under his supervision. This resulted in the final development of a new type of theatre loudspeaker system using a cellular-type for the higher frequencies and a folded directional-baffle type for the lower frequencies. In close cooperation with the engineers of both RCA and Erpi, amplifiers, control apparatus, and soundhead attachments using the rotary stabilizer principle were standardized so that the high quality of reproduced sound could be realized.

It should be kept in mind that by this time the art of acoustically treating theatres properly and economically has been well developed, with most of the large circuit theatres having been so treated.

The next stage in this program was that of agreeing upon a standard recording characteristic which would provide the desired results in the theatre. An attack on another front contributed materially to the campaign. RCA started a suit against Erpi for restraint of trade in connection with the long-term recording contracts entered into with most of the leading picture producers in 1928. This resulted in certain concessions by Erpi to RCA which made it possible early in 1936 for RCA to negotiate with all of the producers for new, modern recording apparatus. At the present time, 20th Century-Fox, Warner Bros., and Columbia are using both Erpi and RCA recording equipments, and RKO are replacing many of their old channels with new RCA equipment. This has also forced a

modernization of much of the old Erpi recording systems.

The introduction during the past few years of a number of fundamental improvements in the processes of recording and printing have made it possible to standardize on a very high quality recording characteristic with an extended volume and frequency range of unusual uniformity.

Both the S. M. P. E. and the Academy of M. P. Arts and Sciences have contributed to the establishment of a recording characteristic that would be acceptable to all producers of motion pictures. Weekly meetings of the head technicians of each studio to discuss the subject and to actually listen to each studio's recordings, as well as the splendid work of a special committee headed by John Hilliard of the M-G-M studios, has resulted in the issuance of a report recently by the Academy outlining very definitely the reproducing characteristic in the theatre which will permit the best results for the recording characteristic agreed upon.

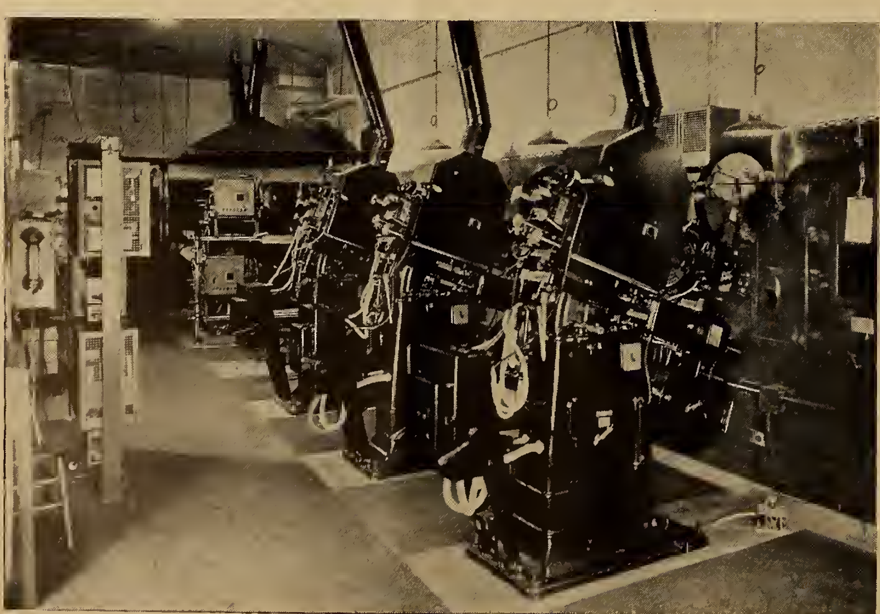
And so all of these interesting developments have finally put the industry in the position where they know just what to put in a theatre to give the best results from the recordings which the studios in Hollywood have agreed to make available on a uniform basis.

At the present time, Loew's, Inc., is equipping all its theatres with the latest RCA and Erpi reproducing systems using rotary stabilizer soundheads, amplifiers of considerable power and output, control equipment of unique design, and two-way loudspeakers consisting of cellular and folded directional baffle units with great power-handling capacity. Warner Bros. are equipping all of their theatres throughout the country with latest RCA apparatus. Many of the Paramount partners are doing likewise, using both RCA and Erpi systems. RKO is modernizing its equipments.

It is conceivable, therefore, for the first time in the history of the industry to forsee in the near future the reproduction of regular release prints of *all* pictures in the largest first-run theatres of the country with a quality of sound nearly comparable to the original sound created in the recording studio.

What effect is this going to have upon the independent exhibitor? In some instances it is possible that these new types of recordings will not sound as good as do the present ones on older types of reproducing equipments. Furthermore, when push-pull recordings are made available, the older equipments will not reproduce them. It will not be possible for the exhibitor to complain to the distributors about the poor recording quality, because the answer will always be that it sounded better than ever in the first-run circuit theatres. If it does not sound so good in the independent theatre, they had better get new, modern, up-to-date reproducing equipment. This is unquestionably going to mean that all of the progressive theatres in the country are going to have to replace or modernize their sound equipment. The latter is generally not possible.

To achieve the new recommended reproducing characteristic as outlined previously, it is necessary that the system be designed for the reproduction of an extended volume and frequency range. The use of ultra-violet recordings printed with the new non-slip devices, properly re-recorded and previewed on modern reproducers will require equipments that can reproduce the softest sounds clearly and distinctly without the introduction of any extraneous sounds (a. c. hum, noises resulting from extraneous light reaching the photocell, dirt on the film, or scratched film) and also the loudest sounds without overload or distortion.



Modern projection room containing simplified sound system, new projector bases and other advanced units which are in sharp contrast to room equipment of 1927

This requires soundheads with means for adequately controlling the film speed at the point of scanning for proper reproduction of the highest frequencies; amplifiers that are a.c.-operated, humless, simple to service, sturdy, and of considerable power output; and loudspeakers of very high efficiency, great power-handling capacity and uniform distribution of all frequencies to every seat in the theatre. The independent exhibitor must keep up with the modern trend and be in a position to make available to his patron the same high-class presentation as offered by the circuit theatre.

Along this same line, it is desirable in most instances to improve the theatre projection apparatus at the same time. The use of 2000-foot reels; the use of larger Suprex type arc lamps for suitable projection of the increasingly popular colored pictures; the use of modern projector mechanisms which will better withstand the intense lamp heat, permit better projection, and through the use of better materials, hardened and ground, reduce the cost of maintenance; together with the new type of soundhead attachments with long motors on the front—all this makes it necessary to install modern, improved pedestals for this heavy apparatus. This can be best done when all of the rest of the equipment, and particularly the sound unit, is replaced.

For a number of years during the depression, the apparatus in the projection room was allowed to run as best it could at a minimum outlay of money. Those days are over for the present, and now is the time to bring the projection room up-to-date. For some time the alibi for poor summer business has been the cost of cooling systems, but now nearly half the theatres in the country have installed such systems.

It is gratifying to note that theatre patrons all over the country have become much more discriminating with regard to both visual projection and sound reproduction. A good picture with the right cast is important, the comfort of the patron in the theatre is important, but the importance of good projection and sound is increasing daily. Here are reasons why the progressive theatre owner must consider the early modernization by replacement of his projection and sound equipment.

Wrap 'em Up!

The projectionist, the "man behind the gun," has his counterpart in another group of "operators"—the studio lighting technicians. An insight into the requirements of this particular profession is had in the appended article which appears here by courtesy of the *International Photographer*, which does a sister act for our West Coast studio friends.

"WRAP 'Em Up!" That order rings out on a sound stage and the day's work has ended for two score electricians. They put their equipment in order and start for home. Sounds like a simple ending to a day's work. But on that sound stage for the preceding ten hours of "shooting" that staccato command would have been just one more order to further confuse the ordinary visitor to any Hollywood studio. Set lighting electricians, or "operators," as they are classified, are in no small measure responsible for success of a picture. Their work is highly specialized and exacting. Their duties are performed in response to a queer jargon of orders from their boss, or "gaffer".

Studio Technicians Local 37 uses around 2300 operators to supply the constant demands of Hollywood studios. Each a specialist, these operators have a thorough knowledge of their work, and competently cope with most difficult problems of lighting. One week an operator may work 60 feet in the air, high over a huge set; and the next week in the musty, dank bilge of an ocean-going tramp freighter off the shores of Southern California; or a few weeks later in far-away Alaska bundled in countless fur wraps and heavy mittens.

Rapidly Changing Conditions

Every location, each rapidly changing setting presents new and individual problems that the operator must instantly master. From the comparative safety of a modern sound stage to handling cables and lamps in a real rainstorm, standing in water highly charged with electricity—no matter the situation—the operator is competent to "deliver the goods."

No less than 30 different types of lamps are standard equipment of the modern film studio. All necessitate complete knowledge of electrical hook-ups, proper voltage, and a mustering of practical knowledge gained only by years of conscientious effort in this specialized field. Volumes could be written on the circumstances peculiar to each set, each new picture, but to the layman, perhaps the jargon used by the operators is the most confusing and least understood of all.

Of the many types of lamps used, each has a different label. There are Crecos, Moles, deuces, fives, rifles, 24's, 36's, 18's, 70's, 120's, 150's, rotaries, babies, matchboxes, juniors, pans, scoops and many others. Other equipment is typed as screens, oils, spiders, four-naught, two-naught, whistle-boxes, snoots, barn-doors, *etc.*

Let's visit a modern sound stage and hear what goes on there. Stop a moment and look around you—ever see so many lights before, and nearly all different? Glance up above you. There's all of one hundred lamps up there, big ones, little ones, every type. The men busying themselves on those narrow platforms, or parallels, are the set lighting operators, preparing their equipment — testing every lamp, cleaning lenses, checking circuits.

The operator is virtually a member of a highly competent fire prevention squad. One faulty hook-up, one short circuit, and this huge stage with its fortune in settings and equipment would be a terrifying bonfire. The operator solemnly understands his responsibilities. Several hundred actors are standing about. Some of them are talking with the electricians, both on the floor and "up high."

Actors know the fire hazard that is always present, and their faith in the operator to guard the actor's life has never been violated. An insecure lamp up there on those parallels could crush out the lives of many actors—many tons of heavy lights hang directly over the actor's head—but securely fastening those huge lamps is just one of the automatic duties that the operator performs so well.

The man by the camera—looking up high—that's the boss in charge of set lighting, called the "gaffer". His assistant at his side is called the "best boy." These two men were selected from the many available to have complete charge of this production because of their ability. The gaffer checks his crew, finds them all in place and ready for his commands. His attitude is one of confidence in the ability of his fellow workers. The operator's only tools are a screwdriver and pliers, for his thorough knowledge of his work is his chief asset.

Random shots of just a few chores in the daily routine of the lighting operator

Two operators wheel a ponderous

Left: "Wrap 'em up" translated into action at the close of the day as studio electricians fold up the huge lighting equipment. Center: the men who boss the lighting set are the "gaffer" and the "best boy"—and here they are in the persons of S. H. Barton and George Neff of the Radio studio. Right: Spectacular lighting for night scene in the current Universal spectacle, "The Road Back".

"sun-arc" into place, a floor lamp is changed, and the gaffer is ready to start. All must be in readiness before the director arrives for the first shot of the day. A "junior" is placed for a key light, is adjusted, and the lighting gets under way. Let's listen to the orders:

Intriguing Working Jargon

"Up high in Bay 12! Hit that Greco —right, it a little—heat it up—screen it! Bay 9—splash those three 18's across the floor—oil the center one a little—flood it! That 150 in the corner—hit it—pull in down across the door—put a snoot on it—cool it off! Bay 16! Crack that 36 across the davenport—ease it off the window—cut into it on the right with a 70—put a barn door on it! Bring that baby over here—O. K. Now wheel in a broad—put a silk on it. Now bring me a rifle. That's it. Now kill both of them!

"Up high in the grid! Hook that 150 into a spider and put a whistle box on it—coal up that dead 120 and backlight the star—hit her hard! Swing that 34 pan to the right—hit all your scoops—O. K. Kill 'em all and stand by!"

It doesn't sound very simple, nor was the lighting any more simple than it sounded. Each order was given with the sure knowledge of what results would be obtained. There is no guesswork in set lighting. Like many other trade jargon, the special vocabulary of the studio operators has been patched together over a period of years. It is a form of verbal shorthand, picturesque and effective.

Now each operator carefully checks his lamps, lest they accidentally be moved the slightest part of an inch. That alone could ruin a shot, and the lamps must not fail in the middle of a "take". The responsibility of each operator is definite and important, and he meets that responsibility with ability born of years of experience.

On location the operator's duties increase. Entirely new situations and conditions demand that he must be both thoroughly competent and resourceful. A race-track, an African jungle, the desert, flood scenes, aboard a steamer, war scenes, a great fire picture being shot, and thousands of other location assignments burden the operator with complex problems, but he must be always ready at the proper time for shooting.

One town has nothing but 220 volts, another 440, this one 110. There are hook-up problems, laying cables through rivers, handling high-intensity lamps in terrific rainstorms—but the picture must not be delayed. The operator always must be ready.

Physical difficulties under which his myriad duties are performed are many. One day he handles a huge sun-arc high over a stage setting—the intense heat from hundreds of lamps making his lofty perch a dangerous one. The temperature often reaches 115 degrees and more, and he must be in condition for such rigorous tasks. A moment's relaxation, a slight fainting spell from the heat, a mis-step on the treacherous rubber-covered cable, and he would go hurtling to the cement stage five stories below.

Tomorrow his assignment may take him into a rainstorm to handle highly-charged cables and lamps, and he must watch ceaselessly against electrocution. Such risks are lessened by a keen appreciation of the dangers involved, plus a thorough knowledge of the art. These are but two of the many dangerous assignments that fall to the lot of the operator.

Local 37 of the I. A. now numbers some 2300 such operators who are daily making such a great contribution to the advancement of the motion picture industry.—HANNA, Local 37, Hollywood, Calif.

World Television Progress Summarized in Second Annual Academy Report

This announcement supplements the report of May 15, 1936, and is therefore a review of a full year's progress in this field, as seen by the Academy Scientific Committee on Television, with particular emphasis on its relation to the motion picture industry.

THE members of the reporting committee are too well aware of both the potentialities and uncertainties of technological research to claim infallibility for such predictions as their task entails. It happens, however, that only one of the forecasts contained in the 1936 report requires, as yet, any essential modification. In every other particular the 1936 report is as valid now as when it was issued.

To quote from that report, it is still improbable that television will burst on an unprepared motion picture industry; many millions of dollars must be invested before nationwide urban exploitation of television becomes possible in the United States; the *start* of such a development, forecast for 1937-38, is confirmed; television service for rural areas is still beyond the calculable future.

The one change to which we would call attention is that recent improvements in the design of electronic projection de-

(*Continued on page 21*)

ALIGNING THE LAMPHOUSE WITH THE PROJECTOR MECHANISM

By *A. C. SCHROEDER*

MEMBER, PROJECTIONIST UNION 150, LOS ANGELES, CALIFORNIA

IT is well known that the optical system, including the lamp and the condensers or mirrors, should be in line with the mechanism. It is not so well known, however, why this is necessary, nor is correct procedure therefor a matter of common knowledge.

When the light source is out of line with the aperture hole and the lens it is difficult to obtain even illumination on the screen, and if the system is very much out, it is impossible to do so, due to loss of light causing shadows or ghosts. When the lamp is off to one side, some of the light does not enter the lens but strikes the edge of the lens jacket, or misses the lens entirely. The area from which this light originates will appear darker on the screen than the other parts.

The degree to which the system can be out of line without causing trouble varies under different conditions; what may be a satisfactory set-up in one house may cause much trouble in another. In other words, there is no "standard" set-up.

Condenser-Type Lamps

In lamps using condensers, the latter can be considered as the light source, because they must be lined up with the aperture and the lens, after which the arc is adjusted by the controls so that the aperture is properly illuminated. The arc will then line up with the rest of the system. If the crater were lined up with the mechanism first, and then the condensers put into place and the light thrown on the screen, it would be necessary to shift the crater to cover the aperture properly, thus misaligning the crater with the head. The exception would be when the condensers happened to be in line.

Another exception is the Brenkert lamp, where the condensers are shifted to get the proper spot at the aperture. Here we would have to line up the crater with the aperture and the lens, then the condensers put in place and the light thrown on the aperture. The condensers would then be shifted by the controls until the spot at the aperture was satisfactory, or until the light on the screen was even.

In this story we will deal mainly with the Suprex lamp, but most of it will also apply to the older low-intensity, mirror-arc lamps, and some of it will illustrate how the condenser-type lamp is lined up.

In Fig. 1 we see an aligning rod, 42 inches long and 8 mm. in diameter. One inch on one end of the rod is 6.5 mm. The smaller diameter fits the negative carbon guide; the larger diameter fits the positive carbon guide. The large round object on the rod fits into the lens holder, thus lining up the rod with the mechanism. The smaller object is tapered on one end, and of an oblong cross-section, to fit the aperture hole. Thus the rod is placed through the optical axis of the lens and also through the center of the aperture hole. The other end will pass through the point where the center of the crater should be and will point to the center of the mirror.

Exception on Old Types

An exception to the foregoing is that the rod is not at the center of the aperture when used on the Powers or the old-style Simplex. Fig. 1 shows that the rod goes not through the center of the small plug but somewhat to one side. An area has been cut off one side of the plug equal to the width of the sound track, plus a small margin for clearance, just as has been done to the aperture hole used on these machines.

If the rod were put through the center of this plug, it would be slightly out of line with the center of the lens opening; or if the rod were positioned so that it *would* go through the center of the lens opening, it would be at an angle. If the lamp were lined up with the rod in this position, it would throw the lamp out of line with the mechanism instead of lining it up, as intended.

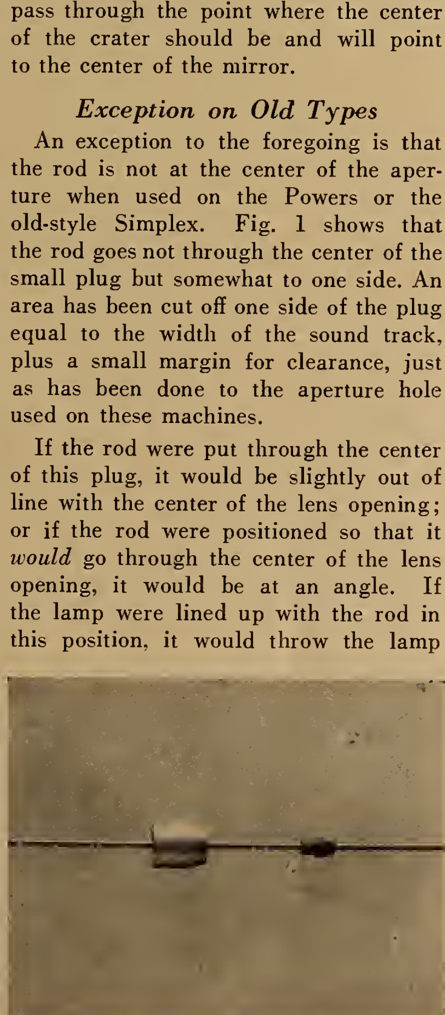


FIGURE 1

As the plug has been made, the rod goes through it at a point to line up perfectly with the lens. The large plug must be placed well into the lens holder, so that it cannot set at an angle, and should be clamped by the screw provided for clamping the lens. The small plug is then slid along the rod and into the aperture hole. If it fits the hole on all four sides, everything is O.K.; if not, either the aperture or the lens holder is out of position.

It is unlikely that the lens holder is out, but not altogether impossible: some of the parts may be cracked or broken, which examination will quickly determine. Assuming that the lens holder is correct, it is necessary to line up the aperture. The removable aperture hole may be filed on one side (the edge of the plate, not the hole itself) and built up with solder on the other, and so shifted until the plug fits into the hole, touching all four sides. On the older Super Simplex this is easily accomplished by the device used for shifting the lens holder, which will adjust the position of the holder and that of the rod line it up with the center of the aperture.

If this rod is used on the Super Simplex or the present Motiograph, the small plug would be replaced by another having the hole in the exact center, or, as previously noted, this plug may be eliminated. When the aperture is fixed there is obviously no need or possibility of any adjustment.

Lining Up the Lamp

With the aperture and the lens aligned, we consider the lamp. The rod should rest easily in the positive carbon guide. If it does not touch the guide, or if it does but the rod is under considerable strain—that is, the guide is bending the rod upward or sideways—obviously the lamp is out of line with the mechanism. In the old days we loosened the thumb nuts used to fasten the Powers head to the base, and rapped the foot of the head with a pair of pliers or a hammer, in order to line things up (a procedure of questionable merit). This can no longer be done, since the head is always driven by gears, the drive mechanism must be perfectly in line and cannot be

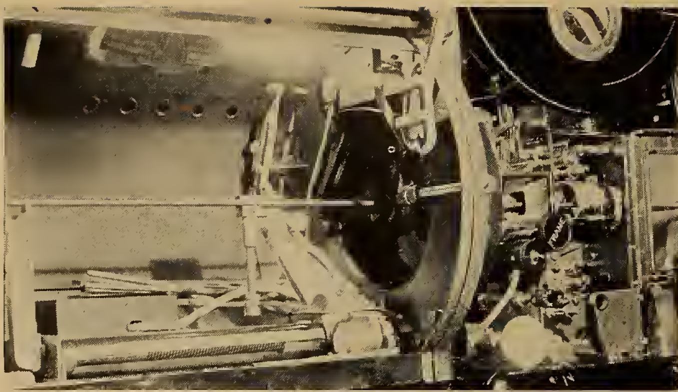


FIGURE 2

thrown out just to line up the optical system.

We must adjust the lamphouse or the bracket on which it sets, either cutting it down or building it up with shims; or if it is off in a lateral direction, the necessary steps to move it sideways must be taken, which may require machine shop work. Does someone say these parts were never wrong? Sorry, but only a small percentage are perfect in this respect, many are pretty good, and some are surprisingly far out.

Figure 2 shows the aligning rod in position, resting in the positive guide, clamped in the positive carbon clamp; then it goes through the cooling plate and the lens holder, and it can be seen through the glass of the door, projecting out toward the screen.

It may not be possible to clamp the rod in the carbon clamp without springing it, *i.e.*, the clamp may be misaligned with the optical system. This is of no consequence. The positive carbon will be at a slight angle; but the crater will be practically in the right position.

With the rod in this position it is possible to line up the negative mechanism, by using the 6.5 mm. end of the rod. Anyone who has operated lamps with horizontal carbons knows that this is incorrect. The negative carbon must be a trifle lower than the position indicated by the rod. It is alright to line the negative apparatus with such a rod when the lamp is first set up; but the final adjustment must be made with the arc lighted and the crater observed. The negative holder is then shifted until the crater burns vertically. Obviously, this adjustment must be made with an arc of the proper length, as a change in the arc length changes the crater angle.

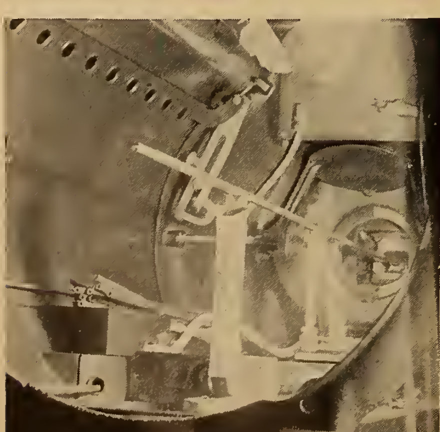


FIGURE 3

In Fig. 3 the back of the lamp is open and the rod is in place. The end of the small plug can be seen faintly where it fits into the aperture.

String Method as Substitute

In Fig. 4 a string has been used instead of a rod. It is just as accurate as the rod, possibly more so, but it requires more time and trouble. Observe that the string is below the center of the cooling plate and also low in the lens holder. This was due to the weight of the fire shutter resting on the string—which wouldn't occur in actual use of this method.

A piece of thread, string or fine wire is tied to the center of a pencil or a small stick. The pencil, or other object, is then placed crosswise over the lens opening in front of the head. When the string is placed under tension, it keeps said pencil in position, and at the same time the pencil can be shifted up or down and also sideways, in order to get the string in the center of the lens opening. The other end is fastened in a similar manner, using a longer stick so that it fits across the large opening at the back of the lamphouse, or it can be fastened to the negative carbon mechanism when the lamp is closed in such a way that it is centered properly.

A pair of inside calipers and a steel scale are needed. Shift the pencil at the front of the head until it looks like the string is centered in the lens opening. Now adjust the calipers so that the distance from the inner lower surface of the lens holder to the string can be calipered, at the extreme front part of the hole. Then caliper the distance from the string to the upper inside surface, also at the front. The two should be the same. If they are not, shift the string slightly toward the side that had the larger distance, until it is centered vertically. Then do the same at right angles to the first measurements.

Now go through the same process at the *rear* hole of the lens holder. If the string is not at the center here, shift it slightly *at the back of the lamp.* Do this until it is exactly in the center. Caliper from the string up, down, and to both sides. One leg of the calipers must touch the wall of the lens holder, and the other leg must *just* touch the string at all four positions. The calipers must not contact the string hard enough to move it.

Having moved the string at the rear of the lamp, we find that this has thrown it out of center at the *front* although it is centered at the *rear* of the lens holder. We must now line the string up again at the front. This will again throw it out at the rear of the holder, but not so much. Each time the string is lined up at one end, it throws the other end out somewhat, but this variance becomes progressively less, and the string is soon at the exact center at both ends of the lens holder.

On the older Super Simplex it is quicker to line up the aperture and the lens holder at the same time. The string and the lens holder are shifted until the string is at the center of the aperture and also in the center of both ends of the lens holder simultaneously.

The string being in line with the head, we now check to see if it also runs through the center of the lamp. The distance from the string to the closest part of the positive carbon guide should be equal to one-half the diameter of the carbon. Lacking a millimeter scale, it is necessary to convert the measurements to the inch scale. (One inch equals 25.4 mm.) Accuracy at this end is not so important; in fact, if you have a good eye it is not necessary to use the scale at all, because one can see when the string runs very nearly through the center of the V and at the right distance above it.

Accuracy at Holder Vital

At the lens holder, however, extreme accuracy is essential. Any inaccuracy in measurement at the ends of the holder is multiplied 15 to 20 times at the lamp. An error of .02 inch at the lens may mean .3 or .4 of an inch at the crater. Make no measurements in the head with

FIGURE 4

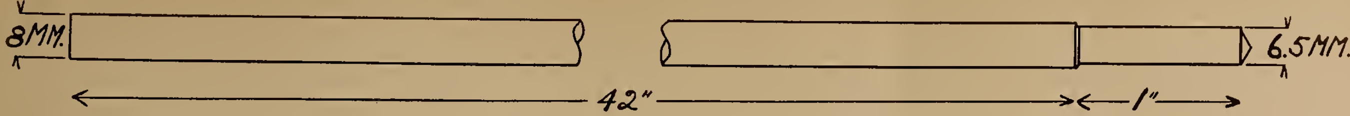


FIGURE 5

the scale, as it is impossible to obtain the needed precision.

Remember that on the old-style heads, where the aperture is off to one side half the width of the sound track, as mentioned previously, we will find that the string must be slightly to the right of the center of the aperture, looking toward the screen.

In using the string on the condenser-type lamps, the two condenser rings are first put in place, but without the condensers. The string is positioned as before, only that it probably will have to be fastened differently at the back end. With the high-intensity lamp it is possible to run the string through the rotating element and fasten it to a stick placed across the hole at the back of the rotating part. After centering the string at both ends of the holder, use the calipers or the scale to ascertain if the string is at the center of the rings. If not, the lamphouse must be shifted until this condition prevails.

When the lamphouse is moved it will throw the string out of center in the lens holder and the aperture, making it advisable to approximately center the string by eye, both in respect to the rings and the holder, moving the lamphouse if necessary. In this way no time is spent at the start to accurately line up the string at the lens, and then throwing it off again when moving the lamphouse into position. When lined up first by the eye, it probably will be sufficiently close to require little shifting of the lamphouse after the string is centered in the holder by the use of the calipers.

Fig. 5 shows the aligning rod. Fig. 6 is the large plug which fits into the lens holder. Only the diameter and length of the cylindrical portion is given. The tapered part only aids in entering the plug into the holder. Dimensions of the tapered end consequently are of no interest, just so this part is not made too large. The two dotted lines represent the center hole.

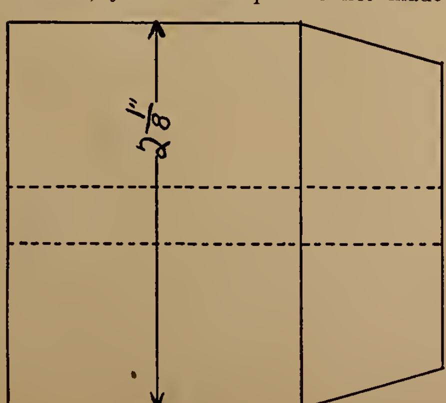


FIGURE 6

Figure 7 is the small plug. The upper left of the drawing shows only the surface of the smallest end. The other two views show the narrow and the wide sides of the plug, respectively.

This device was made by two of the boys in Los Angeles, and they sold many locally. I know of no other place that they can be obtained[1], but any machine shop will make this up at small cost. The rod itself is made of drill rod; cold roll would do just as well. The large plug is a simple turning job. The small plug may be omitted. If the small plug is made up for any of the newer mechanisms, the hole should go through the center of the plug, not as is shown in the drawing. Note that the upper left view of Fig. 7 is not the size of the aperture hole but is made smaller, so that the plug fits into the aperture hole a little way.

Both plugs are drilled and tapped for a set screw, but a ball and a spring are inserted below the screw. This acts as a friction to keep the plug in position on the rod yet does not mar the rod as the set screw would, and it allows the plug to be slid along the rod without bothering with the screw. The hole is not drilled the same diameter clear through, but is slightly smaller just before it breaks through into the hole for the rod. This prevents the ball from falling out when the rod is removed.

The set screw, spring and ball are not shown in the drawings. They may be included in the device if you have one made up, or they can be omitted. The important thing is that the plugs fit on the rod without play.

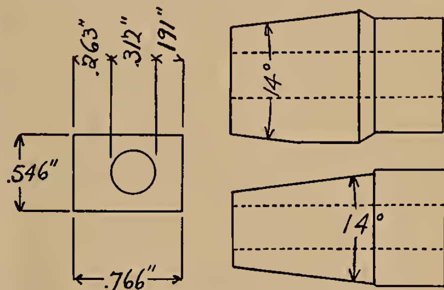


FIGURE 7

[1]Such equipment is also available from Hall & Connolly, Inc., for 125-ampere, high-intensity lamps.

World Television Progress Summarized

(*Continued from page* 18)

vices give promise of a considerable enlargement of television screen areas, the realization of which would vastly accelerate the evolution of television as a practical art.

The British Experiment

It is legitimately claimed for the transmissions inaugurated from the Alexandria Palace in London, on Nov. 2, 1936, that they constitute the first and only existing public television service. For this achievement the governmental and private interests involved deserve the credit due to pioneers in a difficult field. Looked at realistically, however, theirs is still an experiment, as is any enterprise in which more problems are raised than solved. The accomplishments may be summed up as follows:

(1) Regular transmissions for two hours a day over a period of seven months, using an all-electronic system with 405 lines and 50 pictures a second, interlaced.

(2) The sale of not over 1.000 television receivers in a highly populous area within, roughly, a 60-mile radius from the transmitter.

(3) The development of technique and operating organization, including multi-camera pick-up, studio procedure, special effects, training of personnel, accumulation of engineering data, etc.

(4) As a special event, the televising of the Coronation procession, under adverse weather conditions, to some thousands of viewers.

Our British correspondents agree, however, on the following adverse conclusions:

(1) The received pictures, of the order of 7½ by 10 inches, are too small to afford more than scant entertainment value, even if other technical difficulties, such as a consistent lack of definition in the longer shots, are overcome in due course.

(2) The cost of the receivers, 60 and 80 pounds ($278.70 and $371.60) makes television a toy of the well-to-do.

(3) The theatrical content of the video broadcasts has rarely risen above the level of mediocrity.

In short, the picture is small, the cost high, the show poor, and the patronage meagre. Even allowing for the success of the Coronation visual broadcast, we have to date an entertainment *tour de force*, rather than a spontaneous growth in answer to a genuine public demand. As for the economic question, it is no nearer solution than when the experiment was inaugurated. It is argued that

(*Continued on page* 28)

SCREEN BRIGHTNESS THE MAJOR CURRENT PROJECTION PROBLEM

A Report by the Projection Practice Committee of the S. M. P. E.

Among the projects considered by the Committee during the past six months are those of screen brightness; its desirable values and methods of measuring it; the question of using a visual test-pattern for checking screen illumination; revisions of projection room plans; questions of projector motors and take-ups, and difficulties incident to the starting of projector motors; requirements of sound screens; and a recently initiated survey of theatres throughout the United States to determine not only existing conditions of projection, but also for the purpose of establishing a set of recommendations regarding theatre structures.

MANY of the projects engaging the attention of the Committee have been under consideration for a long time, some of them for several years. The original plans for the projection room, drawn in 1930, have been revised several times since. The study of screen brightness has also continued for several years, concurrently with an intensive study of all phases of the subject by the Projection Screen Brightness Committee, which this year was merged with the Projection Practice Committee. In addition, a number of new projects have been undertaken, work on which has not progressed sufficiently to warrant formal report.

It has been found advisable from time to time to delegate specific projects to sub-committees. The active sub-committees at present are:

Adoption of Projection Room Layouts as Standard;
Projector Output and Screen Illumination (including means of measurements);
Suprex Lamp Magnification Ratio;
Motor-Starting Time, Types of Take-up;
Technical Coordination;
Theatre Structures;
Fire Hazards.

It was with deep regret that the Committee learned of the death of Rudolph Miehling on April 7th. Mr. Miehling had long been an active member of the Committee and had contributed very substantially to its work. His loss is keenly felt by his friends and co-workers.

Screen Brightness

Screen brightness was studied at length by the former Projection Screen Brightness Committee and more recently by the present Projection Practice Committee. The latter Committee approved the recommendation[1] of the Projection Screen Brightness Committee to the effect that the brightness at the center of a motion picture screen be held within the range of 7 to 14 foot-lamberts. However, in taking this action, the Projection Practice Committee desires to qualify its approval by calling attention to the following considerations.

Many factors enter in practice to influence the physiological reaction to light stimuli. Some of these were discussed in the Projection Screen Brightness Committee's report published in the Aug., 1936, issue of the S. M. P. E. *Journal*. The Projection Practice Committee cites the following factors as being of first-order importance in this connection. The desirable screen brightness will depend upon the density of the print; whether the picture is black-and-white or color; the visual state of audience upon entering the theatre; the color, width, and brightness of the screen frame and masking; the immediate surroundings of the audience including the location, direction, color, and intensity of the auditorium illumination; and the color of the projection illumination source. In addition, there are various other second-order factors.

Therefore, extreme conditions may exist when 7 foot-lamberts may be more than sufficient, while at other times 14 foot-lamberts might not be adequate. The report of the Screen Brightness Committee previously mentioned has emphasized some of these thoughts. With this explanation of its reservation, this Committee heartily concurs with the findings of the former Committee and believes that their report represents an important advance with respect to the subject.

Screen Brightness Measurements

This Committee will continue its investigation of the practical aspects of screen brightness in theatres, reportin upon its findings as developments warrant.

The function of the sub-committee to which this subject was assigned late in 1936, is to recommend specific apparatus and technic for studying the practical illumination problems of the motion picture screen, as follows:

(1) Brightness (upper and lower limits).
(2) Optimal screen size.
(3) The effect upon the eyes of the viewer of the color characteristic of the light-source.
(4) Auditorium lighting conditions.
(5) Resolution of detail and contrast value.

These items involve many factors; for example, both the intensity and the color of the light reaching the viewer's eyes depend upon the nature and the intensity of the light-source in the projector and the reflection and color characteristic of the screen. The optimal size of the screen, while primarily dependent upon the viewing distance, must also be related to the available illumination. The net effect upon the viewer's eyes will depend upon his state of fatigue, the ambient illumination, print density, and other considerations.

A study of the light intensity reaching the viewer will require research involving viewing motion pictures at various intensities, and determining the effects produced thereby upon the eyes of a number of viewers.

Relative to the selection of means for the measurement of illumination, both incident upon and reflected from the screen, extended study has indicated the virtual inability to repeat or check measurements of this character when made with any of the recognized commercial or laboratory measuring instruments now available. Therefore, careful consideration should be given to the characteristics required in a measuring device to be suitable for making illumination measurements of projection light-sources and light reflected from screens. A brief summation of the more important considerations follows:

(1) Extensive comparisons have demonstrated that the response characteristics of commercial light-sensitive instruments depart significantly from the response characteristics of the average eye. Hence, spectral composition becomes a variable which is likely to affect unduly measurements of such incident and reflected light.

(2) While in specific instances rather wide limits of measurement accuracy can be tolerated in determining whether the conditions prevailing are satisfactory for an audience, it is believed that a tolerance limit of

[1] Report of Projection Screen Brightness Committee, *J. Soc. Mot. Pict. Eng.*, XXVII (Aug., 1936), No. 2, p. 127.

± 5 percent will be required in meters or instruments used for measuring the light performance of projection equipments in different theatres. The interest of one or more of the commercial instrument manufacturers experienced in the development of illuminometers is being sought in an effort to bring about the development of a suitable meter.

Before such an instrument can be designed and manufactured, specification requirements must be determined that will satisfy the following considerations:

(1) The instrument shall provide, for the various types of light-sources encountered in projection rooms, consistent luminosity measurements that are proportional to the visual effect of the light upon normal eyes.
(2) The meter shall be of such dimensions and rugged construction as to be portable and capable of withstanding the handling necessary to its use.
(3) Obviously, the cost of the meter must be such as to *promote* its widespread use throughout the industry.

The nature and present status of the problem as outlined prevents drawing final conclusions at this time. Rather, the Committee proposes to canvass various individuals and companies having potential interest in the problem with the object of organizing a study in a logical and orderly fashion to gain the greatest possible contribution for the common good.

It should be appreciated that the development required will probably prove costly and extensive. Some lengthy period of time may be necessary in which to accomplish it. However, it is believed that instruments capable of the performance desired will be produced ultimately. One of the first requisites indicated by this situation is the creation of a general interest among technical organizations whose contributions will accelerate the development.

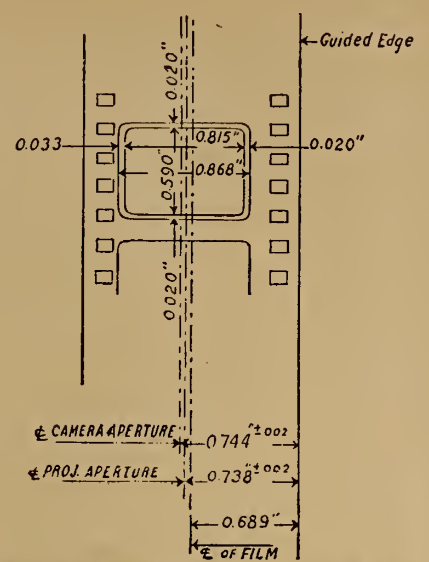
Visual Test Pattern

The plan was suggested of designing and preparing a suitable film containing a visual test pattern to determine whether a projected light falling upon the screen is satisfactory for best viewing conditions. A study of the problem included a review of the reports and papers published in the S. M. P. E. *Journal* by various individuals and by the Projection Screen Brightness Committee.

Consideration of the design of a test pattern included the following factors:

(1) Weber-Fechner Law
(2) Range of print densities
(3) Type of test pattern
(4) Uniformity of illumination over the surface of the screen
(5) Effect of visual acuity of the observer upon use of the test pattern.

The type of test pattern must be one that would give the greatest num-



Recommended area of photographic action

ber of step densities at various absolute values of density for all parts of the screen. Probably the most convenient would be one in which the screen was divided radially from the center in either eight or sixteen sectors. Each sector would have the density steps arranged radially and the density steps of the different sectors staggered to provide each portion of the screen with as many density steps as possible.

Assume that it were possible to make such a test pattern, and in accordance with the Weber-Fechner Law, it still would be of little use since screen illumination is not uniform. The brightest portion is at the center and decreases toward the margins. The reduction of the marginal illumination depends upon the focal length and type of projection lenses used. Hence the design of a test pattern must of necessity take these, and many other variable factors into account.

Finally, no two observers would see the same results due to differences in visual acuity.

It was deemed advisable to include this negative report in the hope that a different method of attack may be devised by some one which will lead to a solution of this problem.

Projection Room Plans

A partial revision of the projection room plans published in the Nov., 1934, issue of the S. M. P. E. *Journal* was made, and although the revisions were not sufficiently extensive to warrant republication, several thousand copies of the revision were prepared in pamphlet form for distribution throughout the world. The intention was to distribute this report as widely as possible in order to arouse a realization throughout the country of the great lack of uniformity in regulations pertaining to projection in theatres, and to attempt to enlist the assistance and solicit the suggestions and criticisms of law enforcement and fire prevention departments of states and municipalities, so as eventually to be able to draw up a model set of regulations that can be recommended to the law-making bodies throughout the country.

Letters directed to the various States of the union indicated considerable misunderstanding regarding the purpose of the booklet, and it was accordingly ruled by the Committee that the following caption be imprinted upon the covers of the pamphlets in order to clarify the situation:

"The material herein presented is recommended practice for new theatres, and for alterations of existing theatres. It is not proposed as obligatory for existing theatres."

This provision must be clearly appreciated in view of the fact that certain differences exist between some of the recommendations contained in the pamphlet and certain regulations of the National Fire Protection Association. Further study of projection room and projection conditions is being conducted with the possible view of preparing a set of practical regulations reconciling these differences.

Projector Motors, Take-Ups

Difficulties encountered in projection with regard to motors and take-ups are:

(a) Fast starting of the projector motor, which strains the gears and damages the film;

(b) Irregular action of the take-up, with the result that jerks are transmitted to the film, tending to tear the sprocket holes at the hold-back sprocket. If the pad roller on the hold-back sprocket is of the single-roller type, and the jerk of the film is excessive, the film is likely to be damaged and jerked from the sprocket entirely.

Jerking of the film may be caused either by rough action of the clutch, slippage in the drive belt types, or slack in the drive in either the belt or chain type of take-ups.

Either the adoption of the following

(*Continued on page 26*)

Members of the S. M. P. E. Projection Practice Committee

H. Rubin, *Chairman*

J. O. Baker	J. J. Hopkins
T. C. Barrows	C. F. Horstman
F. E. Cahill	D. E. Hyndman
J. R. Cameron	J. J. Kohler
A. A. Cook	P. A. McGuire
J. K. Elderkin	E. R. Morin
J. J. Finn	M. D. O'Brien
R. R. French	G. F. Rackett
E. R. Geib	F. H. Richardson
A. N. Goldsmith	B. Schlanger
A. Goodman	C. Tuttle
H. Griffin	J. S. Ward
S. Harris	V. A. Welman

A. T. Williams

NOTES *from the* SUPPLY FIELD

★

FIVE new Lafayette theatre amplifiers are offered by Wholesale Radio Service Co. These range in output power from 5 to 90 watts. All have photo-cell input connections, serving as microphone amplifiers that, in an emergency can be used for film operation, or as film amplifiers completely equipped for stage work.

New circuit features include automatic volume expansion, automatic volume contral, cathode ray monitor tube and reverse feed-back. Standard features include mixer-fader input circuits, gain enough for low-level crystal or velocity microphones, beam power tubes, shielded input connections as precaution against hum, and tone control. Change-over from photo-cell input to microphone or other sound source is effected merely by removing one input plug and substituting another in the same jack. The wiring arrangement for photo-cells supplies the cells with polarizing voltage drawn from the power circuits of the amplifier.

Change-over from automatic volume control to automatic volume expansion is effected by means of a polarity-reversing switch. In each case a portion of the input signal is routed through a separate amplifying tube provided for this purpose, and then rectified, and the d.c. thus obtained applied as grid bias to one of the voltage amplifier tubes. The polarity-reversing switch changes the sign of that bias, and, accordingly, the volume of the input signal either increases or decreases the gain of the amplifier.

In automatic volume control operation, a loud input signal reduces gain, and *vice versa*, thus tending to keep the output level constant at all times. This is desirable in microphone operation, since it allows the performer to turn his face away from the microphone in a natural manner without any great reduction in sound volume.

The cathode ray "monitor," identical with the "tuning eye" common in radio receivers, can be set to close at any volume level previously found desirable. Once the proper setting is selected, monitoring volume by observing the eye is far more accurate than by conventional methods.

All features mentioned are found only in the largest amplifiers. The smaller amplifiers do not have as many, and the very smallest do not even include reverse feedback. All, however, have polarized plug photo-cell input connections, photo-cell voltage supply, speaker field power supply, tone control and mixer-fader input circuits. All have gain enough for any photo-cell or any type of microphone, and require no pre-amplification.

ERPI DEVELOPS 'SOLOLAM'

Erpi, in designing the multi-cellular high frequency horns for its Mirrophonic sound systems, claims to have perfected a material "Sololam," combining the utility of metal with the deadness of wood. The new material, the company says, may be bent to practically any shape and soldered to other sheets without losing its unique properties. In addition to its use in making horns, it is valuable for soundproof and fireproof partitions and various other sound and heat insulating problems.

NEW MANUFACTURER GROUP

The outstanding development at the four-day meeting of the Independent Supply Dealers' in Chicago, June 18-20, was the formation of the Theatre Equipment Supply Manufacturers' Assn., composed of manufacturers alone, who plan an annual international show in cooperation with supply dealers, producers, distributors and architects.

The new organization grew out of the situation here this year, which found two factions fighting for leadership, the dealers in almost continuous conference, and little or no attention paid to the exhibits of the manufacturers. Plans for the manufacturers' show next year will be made by a committee composed of Joseph B. Kleckner, chairman; Oscar Neu, William Geddris, H. C. Hecht, Harry Strong, C. H. Ashcraft and Joe Robin.

The committee will hold numerous meetings within the next few months. Major and independent producers will be contacted, and commercial and educational film producers will also be asked to cooperate in the venture, which is expected to be held here, probably in June of next year. It is also thought probable that the 1939 show will be held in New York to coincide with the New York World's Fair.

NEW AEROVOX CATALOGUE

The new Aerovox catalog has twice the number of pages of recent editions. A new handy listing of all types of condensers facilitates finding just the kind of condenser best suited for any given application. Copies are available to I.P. readers from the Aerovox Corp., 70 Washington St., Brooklyn, N. Y.

NOTES ON THE MECHANISM OF HEARING

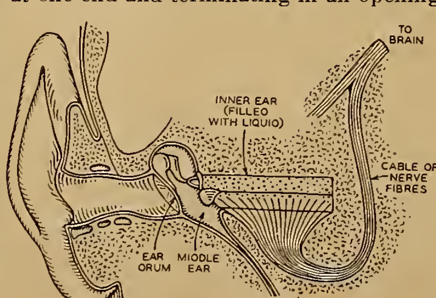
BY A MEMBER OF THE STAFF, BELL TELEPHONE LABORATORIES

THE word loudness is familiar to everyone and is used very frequently to describe the magnitude of a sound. We say that some sounds are "twice as loud" as others or "only half as loud," but in doing so it is seldom appreciated that such statements really depend upon personal judgment and cannot be verified with a meter or other apparatus.

The only true loudness meter is the person who hears the sound. Many experiments have been made to find a scale of loudness that could be used with a person's loudness estimations.

The lack of precision in loudness estimations does not mean that the human ear is a crude mechanism. On the contrary, its construction and operation is very complex. The parts of the ear involved from the time a sound wave strikes it until the stimulus arrives at the brain and we become conscious of its presence are illustrated schematically in the accompanying drawing.

The motion of the air particles is gathered in by the outer ear and focussed on the ear drum. This makes the membrane move to and fro. The motion is carried through the middle ear into the inner ear by means of a delicate chain of small bones attached to the ear drum at one end and terminating in an opening



How sound is transmitted by the ear drum to the liquid in the inner ear and then to the auditory nerves

into the inner ear at the other end. The inner ear is filled with a liquid to which the stimulus is transferred from the chain of bones, as illustrated.

Submerged in the liquid is an elaborate keyboard called the "basilar membrane," and figuratively speaking, the incoming stimulus taps out its tune on this keyboard and thus it is telegraphed through nerve fibres to the brain. The keyboard consists of hundreds of nerve endings arranged much like the keys of a piano in that the high notes are at one end and the low notes at the other. When the nerve endings are agitated by motion of the liquid, pulses of nerve energy are started on their journey through connecting nerve fibres to the brain.

The fibres, bundled together with insulating sheaths, form a cable similar in many respects to modern telephone cables; the pulses of nerve energy carried by the fibres are electro-chemical in nature, and consequently can be measured just like an electric current in a telephone wire.

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

DEVELOPMENT and use of the Keller-Dorian color process by Grand National Pictures has been indefinitely postponed. Urgent need of new capital is the reason advanced in official quarters; but another report is that G. N., finally awakening to the difficulties of reproduction (the K.-D. process requires a filter and the alteration of existing projection equipments) has decided against using the theatres as "experimental stations".

An editorial in I. P. for April, this year, said, in part: "It is wholly unfair, if not incredibly stupid, on the part of producers to expect that they can use the theatres of America, which charge admission, as laboratories wherein color film problems will be worked out on the basis of trial and error. Should they adopt this course . . . one can only shudder at the havoc that will result—not only through the discrediting of color pictures but to the industry as a whole."

K.-D. itself admits that six months more and $100,000 additional cash will be required to "perfect" the process.

Academy Activity Curtailed By Organizing Drives

Informed quarters predict that by next September the Academy of M. P. Arts & Sciences will be completely removed from the economic side of the industry and will function merely as a social, technical and cultural body. Academy dabbling in the affairs of actors, writers and other Coast talent has been eliminated by the organizing of these groups. It is expected that the Academy will confine itself to publication of production, statistics, including talent credits, will continue the annual "best performance" awards, and, most important, expand the work of its Research Council, which lately has been increasingly active on technical problems in both the studio and theatre fields.

St. Louis Wins 2-Men Shift

St. Louis authorities have approved a bill which tightens regulations relating to motion picture projection. Included are provisions for one man for each projector (two-men shifts); for toilet facilities, for not more than 2000 feet of film on any reel, and for periodical inspection to ensure adherence to ordinance. The bill went over despite intense exhibitor opposition.

Nazi Stereoscopic Camera

AGFA (I. G. Farben concern) has developed a new photographic method for use in judging sporting contests, reports U. S. Commerce Dept. Two slow motion cameras are combined to make stereoscopic shots of the events at the goal at the rate of 100 pairs a second. The time is also indicated on the film. By this method it is possible to fix time differences up to 1/1000 second. By a special process the films can be developed within 10 minutes after taking.

25th Anniversaries Observed

Twenty-fifth anniversaries were celebrated during the month by Locals 245 (Salem, Mass.); 249 (Dallas, Tex.) and 253 (Rochester, N. Y.). Each unit sponsored an elaborate party, with the latter also acting as host to delegates to the semi-annual meeting of the N. Y. State Assoc. of Projectionists. Latter outfit approved a drive to unionize theatres in small towns and villages in N. Y. State.

8 Canadian Fires in 1025 Theatres in Year

Only 8 of the 1,025 theatres in Canada suffered any kind of a fire during the past calendar year, according to a report from J. Grove Smith, Fire Commissioner of the Dominion Government, before the annual convention of the Dominion Fire Prevention Assn. The total loss incurred in the 8 fires was only $3,176, making the theatres of the country the lowest fire risk of any branch of business.

Vancouver, B. C., projectionists have been waging a year-old fight in resistance to a proposal to loosen existing 2-men shift regulation by providing for use of "apprentices". Strongest projectionist argument was on increased fire hazard when manpower is reduced.

Film Technicians Object

Appended hereto is a letter to the editor of *Variety*, show-business paper:

"Film Technicians' Independent Union was formed by the erstwhile members of Local 669 of the I.A.T.S.E. We also have in our organization the workers in many laboratories that the I.A. could never organize. All offers made to us by the I.A.T.S.E. have been rejected and measures have been instituted by our legal advisor, Vito Marcantonio (former Congressman) to procure recognition for the Film Technicians' Independent Union. We are enclosing a copy of The Magazine, official organ of the F.T.I.U. It should dispel all rumors about our relationship to the I.A.T.S.E."

Heavy Reel Cases Out in Conn. Exchanges

Allied Exhibitors of Connecticut has informed all exchanges that shipments of film should no longer be made in cases of over three double reels. Five-reel cases have proven dangerous in lugging up to projection rooms it is claimed. The notices inform exchanges that after 30 days, film will not be accepted in the large cases. Universal and United Artists are already complying with the request.

A. T. & T. Patent Changes

DeWitt C. Tanner has been made consulting patent counsel of A. T. & T., and is succeeded as general patent attorney of W. E. by Franklin T. Woodward. Joel C. R. Palmer, patent attorney of W. E., has been appointed contract counsel of Erpi.

A. F. of M.—I. A. Pact Is Denounced by Former

Resolutions introduced at recent A. F. of M. convention charged that agreement with I.A.T.S.E. had been used to disadvantage of Federation, demanded repudiation of the pact which was "proving more and more unsatisfactory and antagonistic to our interests," and instructed Pres. Joseph N. Weber to use his "good offices" to bring about a "satisfactory adjustment". Musicians and I. A. have had a mutual assistance pact for years.

Weber reported to the convention that picketing of theatres to restore orchestras had been unsuccessful and questioned wisdom of continuing campaign.

Television at World's Fair

Television in all its ramifications will be publicly demonstrated at the forthcoming World's Fair in N. Y. City during 1939. This baby science will be only one attraction of a vast RCA exhibit thereat which, entitled "The World of Tomorrow" will show all radio and sound-picture developments, including studio production and theatre reproduction.

Deletion of Feature Shots Violates Release Contract

Not infrequently projectionists are instructed by theatre management to eliminate a scene or scenes from releases, particularly when the exhibitor spots in a feature that which he considers advertising matter. The action of a Mass. exhibitor in eliminating such shots brought the following letter from the distributor's legal department:

"Authentic backgrounds of well-known districts in cities, used as backgrounds for feature motion pictures, will always reveal the actual advertising signs of various commercial concerns. We note your instruction to projectionists to eliminate the advertising

sign, to which you object, by a slight misframe of the title.

"We call to your attention Article Eighteenth of our standard form of license agreement, which provides that the Exhibitor shall exhibit each print in its entirety and further provides that the Exhibitor shall not cut or alter any print except for the purpose of making repairs or to abide by the decision of a censor authority. We therefore further notify you that any such suggested misframing is in violation of the contract."

SCREEN BRIGHTNESS BIG PROJECTION PROBLEM

(*Continued from page* 23)

specifications as standard, or the submission of them to the manufacturers of projection equipment, should help considerably in reducing the difficulties outlined.

Motor Starting — Experience shows that a starting time of two to three seconds seems to be quite satisfactory. The acceleration of the equipment from zero to full speed should be approximately steady, and under no circumstances should have a break in the speed-time characteristic. This latter point is mentioned because the use of a resistor in the starting winding for slow starting, and short-circuiting of this resistor as the motor comes up to speed, is likely to cause a jerk in the equipment at the time the resistor is shorted.

Recommended Take-Up Design

Take-Ups—The design of take-ups should be of such that the pull of the film is steady at all times, irrespective of the amount of film upon the take-up reel. It is preferable to use double pad rollers on the hold-back sprocket to insure that the film stays upon the sprocket at all time.

Projectionists using the equipment can reduce film damage by making certain that the film is not slack between the take-up reel and the hold-back sprocket before starting the projector.

The accepted practice and requirements with regard to the transmission of sound through motion picture screens have not undergone any appreciable changes since they were established during 1930 and 1931. The only major difference refers to the losses allowed at the higher frequencies.

Sound Screen Transmission

The screens in common use at present are those in which the sound waves are transmitted through the air spaces in the screen material. These air spaces may be either the pores of the material or perforations punched into the material. Because of optical characteristics of the screen material, the perforations or air spaces should be as small as possible and the number of perforations a minimum.

As a result of tests, it was decided to limit the aggregate open area for the screen to 7.5-10.0 per cent of the total screen area. The ratio of the thickness of the screen material to the area of a single opening should be

very small, because the air in the individual air passages presents a mass reaction to the flow of sound energy.

The frequency response of a screen enters into the determination of its suitability from an acoustical standpoint. No serious trouble is experienced with regard to the low-frequency response, but a drop occurs at the higher frequencies. Losses at various frequencies were limited as follows:

4.5 decibels at 10,000 cps.
2.5 decibels at 6000 cps.
0.5 decibels at 1000 cps.

Each of these figures represents an average value taken from measurements having no variations due to testing procedure that exceed plus or minus 2 db.

On the whole, it is quite difficult to set definite limits for screen transmission to cover all possibilities, but if the tolerances given above are adhered to, efficient results will be obtained.

Theatre Survey

In order to obtain information that would assist in the study of screen brightness and varous other matters, such as projection angles, seating areas, general lighting, in addition to a number of projection and screen characteristics, a chart was drawn up containing skeleton diagrams of the vertical and horizontal plans of a theatre. Several thousands of these charts were distributed among a number of large companies of the industry whose engineers are assisting in obtaining the dimensions requested on the chart. The chart was published herein. Accompanying the charts distributed were letters describing its purpose.

The theatres covered in the survey include all classes, both as to size and general construction, and there will be sufficient representation to permit a very reliable analysis of conditions. As it will require considerable time to make a thorough analysis of charts that are returned, it may not be before October that the Committee will be able to render a report on its findings.

With the information thus obtained, the Committee hopes eventually to be able to construct plans for various types of theatres, just as they have been able to construct plans for projection rooms. These plans are to include schedules of screen sizes, screen brightness, and other matters of importance to architects and others engaged in building new or altering existing theatres.

Mutilation of Film

In view of the fact that devices have been placed upon the market by means of which projectionists may place upon films cue marks for change-overs, the following resolution was adopted by the Committee:

"The Committee does not approve any structural modification, injury, or mutilation of the S.R.P. by the projectionist, and views with disfavor the sale of devices capable of causing physical damage to the

film for cue marks or the like. The Committee regards cue-marking as a function exclusively of the laboratory."

Picture Apertures

Since the adoption of the standard camera and projector apertures several years ago, these standards have not fulfilled the requirements for which they were created, due to failure to consider the masking at the theatre screen.

To overcome objectionable blocking out by the screen masking of important parts of the photographed action, it is recommended that action being photographed be limited to an area 0.005 of an inch smaller on all sides than the dimensions of the standard projector aperture.

The following will outline in general the differences between the camera and the projector apertures:

Camera	0.868	0.002	inch wide
	0.631	0.002	inch high
	0.744	0.002	inch center-line from guided edge
Projector	0.825	0.002	inch wide
	0.600	0.002	inch high
	0.738	0.002	inch center-line from guided edge

Experience has shown that, on a 9 by 12 foot screen at an angle of projection of approximately 15 degrees, a 1-inch masking around the screen into the projected picture has proved sufficient to assure proper projection. This 1-inch masking represents a decrease of 0.005 inch approximately on each side of the projector aperture, or an aperture 0.815 inch wide by 0.590 high, 0.738 ± 0.002 inch from center-line to guided edge.

The Committee recommends, in view of the facts given above and in order to avoid loss of portions of the picture, that cameramen and studio laboratories provide their camera-focusing devices and view-finders with a working ground-glass having a rectangle of the conventional thin black line corresponding to the dimensions 0.815 by 0.590 inch, as an aid to the cameraman in composing his picture.

The Committee also recommends that a minimum masking or overlapping of the projected film image upon the screen be established. For example, on a 9 by 12 foot screen the masking should not overlap the projected picture more than one inch on each side; for smaller or larger screens this masking or overlapping on each side should be of the same approximate ratio.

WORLD TELEVISION SUMMARY

(*Continued on page 21*)

if larger governmental subsidies can be secured, better shows will become available, and eventually widespread public interest and participation can be enlisted. Perhaps so.

In the case of British television it is too early to draw conclusions. At the moment one can only say that such an efflorescence is a hope rather than an early probability. By the end of the year there should be signs of a healthy impetus from within, or the enterprise will begin to have the appearance of that languishing type which needs interminable injections of outside aid.

American Television Developments

In the United States the active television interests have accepted the R.M.A. Standard of 441 lines, a frame frequency of 30 pictures a second, a field frequency of 60 pictures a second, interlaced, and an aspect ratio of 4:3, the same as in motion pictures. These are the present characteristics of the test transmissions by the National Broadcasting Co. from the Empire State Tower in New York, which are the nearest American equivalent to the British operations reviewed. (The former, however, is not a public service; the receivers, of which there are over one hundred, being in the hands of RCA executives and engineers who report confidentially on the results.) The shows originate in a special studio in the RCA Building and are relayed to the transmitter over a coaxial cable and a radio link between the two buildings, whose airline separation is under one mile. The power of the transmitter, 7.5 kilowatts, is sufficient to lay down a satisfactory signal on the optical horizon, which is some 43 miles from the top of the 1250-foot tower.

The size of the received pictures is about the same as in the British case: $7\frac{1}{2}$ by 10 inches. Such a picture is afforded by a $12\frac{1}{2}$-inch cathode ray tube, a size readily manufactured in the present state of the art.

This experimental service has been in operation for about eleven months with an interval to permit changing the transmitter from the earlier 343-line standard to 441 lines, and some briefer interruptions. A mass of data on the technique of televising, electrical interference conditions, signal distribution, *etc.*, has been and is being collected. Papers describing the technical aspects of the research are presented periodically before the

S.M.P.E., the I.R.E. and other recognized bodies.

In connection with one of the most recent of these papers there was a demonstration on a scale as large as 10 by 8 feet, using optical projection from a kinescope equipped with a suitable lens system, with, it is said, impressive results. (Similar experiments have been carried on in Germany, but there it was reported that the optical quality of the larger pictures was unsatisfactory.

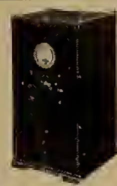
Occasional television programs are transmitted from a Philco station in Philadelphia, and others. Columbia Broadcasting System has announced its intention of installing a television transmitter on the Chrysler Tower in New York.

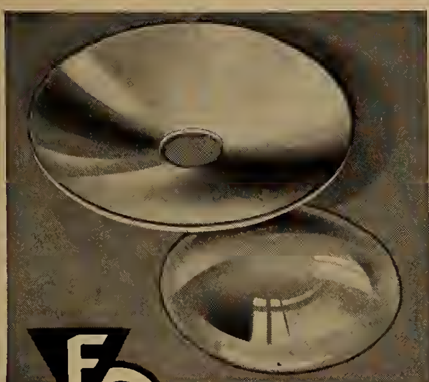
In Germany there is considerable television activity. Scenes from the Olympic Games were televised, but apparently the results were unimpressive. In France the forthcoming installation of a 30-kilowatt transmitter on the Eiffel Tower is announced. There are also reports of Russian purchases of television equipment in the U. S.

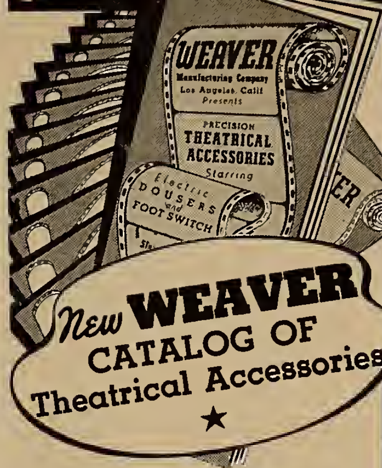
General Considerations

Both here and abroad, systematic engineering progress is being made in the development of high-definition television. The situation has reached a point where it warrants careful study and observation. Just as the physical equipment required cannot be brought into existence quickly, it is impossible to acquire overnight a background in a field as complex as television, and study well in advance is a prerequisite of wise and economical planning. *The time is not far off when those engaged in motion picture production, and others whose interests are likely to be affected by the evolution of this new field, will do well to acquire as much familiarity as possible with its characteristics and methods.*

We recur to the question of picture size. As soon as larger pictures are available with the requisite photographic quality, television may be expected to gain marked impetus, and commercial application in the larger urban centers will not be long delayed. The lesson to be derived from the British experience to date may be that when those in a position to gauge entertainment value advise that a given picture size is inadequate for successful commercial application, no purpose is served by trying it out on the public. The likelihood of a







favorable verdict does not increase with the size of the jury.

For the United States, it is to be hoped that no attempt will be made to commercialize home television until a picture equivalent in definition to the best home-movie projection, and not smaller than 24 by 18 inches, can be furnished with routine reliability. The most important interests in the domestic field appear to be committed to some such prudent policy.

New York and Los Angeles together constitute the principal reservoirs of movie, radio, and television talent in this country. It may be expected, therefore, that when the problems of providing television service for the New York area are well on the way to solution, say in 1938 or early 1939, the next major urban area selected for television coverage will be that of Los Angeles. The topographical and physical conditions in the two regions are quite different, and, it would appear, are on the whole more favorable in the West.

In New York the land elevations are relatively low, no point in any of the five boroughs, excepting Staten Island, being as high as 300 feet above sea level. To secure short-wave coverage, therefore, it is necessary to radiate from high buildings, of which there is no scarcity. However, the mass of steel structures on Manhattan of necessity casts radio shadows which complicate the problem of television distribution.

Situation in Los Angeles

Los Angeles, in contrast, is a city of low structures, but natural elevations provide numerous sites from which television service could be effectively provided. Cahuenga Peak, for example, with an altitude of 1825 feet, affords an eminence about half again as high as the Empire State Tower, commanding the San Fernando Valley to the north, the greater part of Los Angeles to the south and east, and the beach cities to the west. Topographically, as well as from the aspect of talent availability and entertainment facilities, Los Angeles is a peculiarly favorable site for a television center.

In view of the progress being made in television, this Committee feels it advisable to report its findings semi-annually hereafter, and is scheduling its work accordingly. The next report will thus be issued in January, 1938.

There IS a *Difference!*

USE GENUINE *Simplex* PARTS
TRADE MARK REGISTERED

GIVES 5 TO 6 TIMES MORE *Safe* SERVICE

PROTECT YOUR PATRONS

•

PROTECT YOUR POCKETBOOK

THEY look alike . . . BUT what a *difference!*

The GENUINE Simplex Star Wheel and Shaft will give you 5 to 6 times more *safe service.* It assures this much longer service because, unlike the imitation, it is *hardened* . . . not merely case-hardened, but hardened *clear through.*

It assures better projection because of its matchless accuracy... accuracy that is held within 1/10,000 of an inch at 21 different points!

Don't gamble in replacing star wheels. Just think...157,680,000 times a year the cam pin of the Simplex Intermittent Movement slides in and out of the star wheel slot. Star wheels *must* withstand great wear . . . or projection will suffer.

When repairs are made . . . insist on GENUINE Simplex Parts *exclusively.* They cost so little that you can't afford to take a chance on substitutes.

INTERNATIONAL PROJECTOR CORP.
88-96 Gold Street New York, N. Y.

DON'T TAKE A CHANCE...USE ONLY

GENUINE *Simplex* PARTS
TRADE MARK REG'D

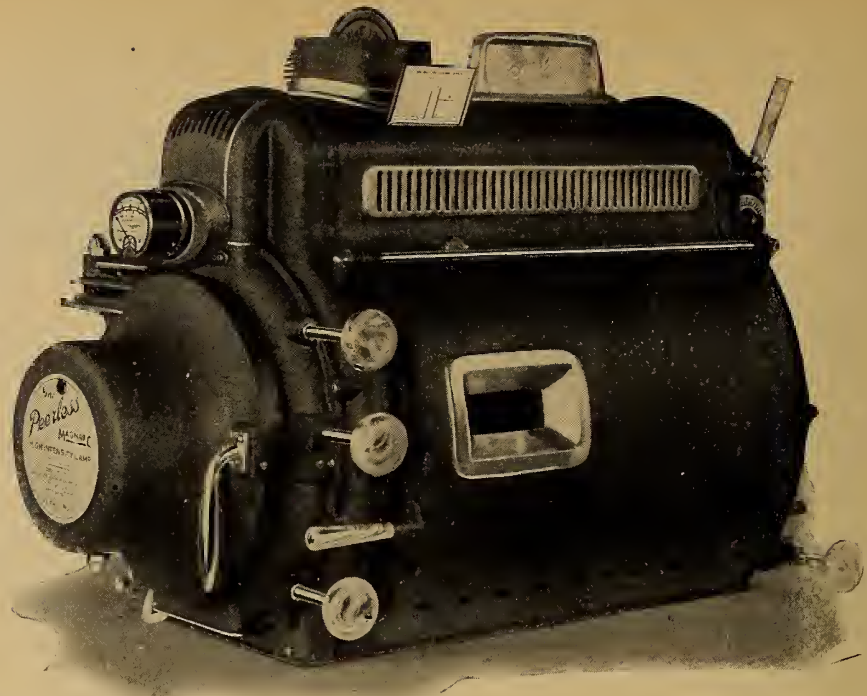
DISTRIBUTED BY NATIONAL THEATRE SUPPLY COMPANY

Ip

International PROJECTIONIST

JULY, 1937 Vol. 12, No. 7

25c Copy $2 a year



Peerless

MAGNARC

TRADE-MARK REG.

JUST AS THEY BECAME THE BIG THEATRES ALTERNATIVE THEY ARE NOW INDISPENSABLE TO <u>EVERY</u> THEATRE

HIGH INTENSITY LAMPS

THEY RETURN THEIR COST!

It has been proven time and time again that no theatre was so large that its projection could not be infinitely improved and operation costs reduced by the installation of Peerless Magnarcs. Just as true is the fact that no theatre is so small that it can afford to be without them. The wide current range of the Peerless Magnarc (35 to 65 amps.) makes it indispensable to theatres of *all* sizes.

When operating cost is based on the volume of light obtained, *nothing* can approach the great economy of the Peerless Magnarc.

Up to 300% gain in screen illumination can be had at the same current cost of any low-amperage reflector arc lamp.

It's the light that puts *life* in your picture. You have it in abundance when you own a Peerless.

"THE FINEST ARC LAMP EVER BUILT"

MANUFACTURED BY

J. E. McAULEY MANUFACTURING CO.

552-554 WEST ADAMS STREET CHICAGO, ILL., U. S. A.

SOLD BY

NATIONAL THEATRE SUPPLY COMPANY

OFFICES IN ALL PRINCIPAL CITIES

International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 12 JULY 1937 *Number* 7

Published Monthly by

JAMES J. FINN PUBLISHING CORPORATION

580 FIFTH AVENUE, NEW YORK, N. Y.

Circulation Manager, RUTH ENTRACHT

SUBSCRIPTION REPRESENTATIVES

AUSTRALIA: McGills, 183 Elizabeth St., Melbourne

NEW ZEALAND: Te Aro Book Depot, Ltd., 64 Courtenay Place Wellington

ENGLAND AND DOMINIONS: Wm. Dawson & Sons, Ltd., Pilgrim St., London, E. C. 4.

YEARLY SUBSCRIPTION: United States and possessions, $2 (two years, $3); Canada and foreign countries, $2.50. Single copies, 25 cents. Changes of address should be submitted two weeks in advance of publication date to insure receipt of current issue. Entered as second-class matter February 8, 1932, at the Post Office at New York, N. Y. under the act of March 3, 1879.

420

MONTHLY CHAT

PROJECTIONISTS in the province of British Columbia, Canada, are now waging a bitter battle with exhibitors for the preservation of the two-men shift standard, long maintained on the statute books. In the absence of a central bureau to which a craft unit could turn for expert aid in such a situation, where did the B. C. boys get their dope?

The answer to which query is a short editorial: Just here, and there and most anywhere—that is, if the parties appealed to were sufficiently interested or not too busy to help. Nice goin' indeed, for one of the prize units of the organized Labor movement.

THAT explosion in the sound equipment merchandising field that we mentioned two months ago is about to be touched off. The new facade about to be grafted on the face of the supply field will constitute an intriguing architectural accomplishment.

THE S.M.P.E. now reports a total membership of 1300, including a couple hundred projectionists at a minimum of $6 a throw. This is all to the good; but we recall the difficulty experienced by the Projection Advisory Council, the "operator's" own mob, in getting $1 annually. It's a funny world.

INSTRUMENTS of every description for tests of every description are now flooding the projection field. This calls for extreme care in purchasing. I. P. will gladly give the low-down on the worth of any contemplated purchase.

WE EXPECT soon an announcement of larger Suprex-type carbons. The reaction of those unfortunates who will be caught with thin-metaled and undersized lamphouses ("but cheap") and power sources already skirting the danger-line will not be funny. But all the aspirin-reaching will not reform the boys—not in "our great industry!"

MR. SAMUEL GOLDWYN will make no more pictures in black-and-white, says he. Mr. Samuel Goldwyn may make so many pictures in color that he soon will be making no pictures at all.

RECEIPT recently of an "invitation" to study television by correspondence upset us no end. We were playing with the idea of putting out such a course ourselves, and now along come divers interlopers to cut in on a potentially lucrative racket.

STILL available is a limited quantity of characteristic charts of all W. E. and RCA sound picture tubes. First come, first served; and then no more.

INTERNATIONAL PROJECTIONIST

VOLUME XII NUMBER 7

JULY 1937

AN EASY METHOD FOR MAKING EFFECT SLIDES AND APERTURES

By *A. C. SCHROEDER*

MEMBER, PROJECTIONIST UNION 150, LOS ANGELES, CALIFORNIA

IT IS sometimes necessary to make new apertures, or to have them made. The usual procedure is to file a little and then shoot the light through it to see how it fits the sheet; then file some more and try again. When one is finished, the whole thing is repeated for a second and, sometimes, a third. The same aperture does not always fit both machines, due to different angles of projection. Where the angle is sharp, or when the throw is short and the picture is large, we encounter this trouble, especially if the machines are some distance apart.

If a pattern were available it would save much trouble. Such a pattern can be made by placing a piece of photographic paper in the exact position that the aperture normally occupies, with the shiny side toward the screen, then throwing the light from the other machine on the screen and making a photographic copy of the screen on the paper. We assume that there is black screen masking and that the light from the opposite machine overlaps onto the masking somewhat, thus ensuring that the entire screen is well illuminated.

The light hitting the masking will not photograph, or so slightly that it will not matter. This will give a black four-sided object on the paper and when developed and fixed it becomes a good pattern by which the aperture can be accurately filed with a minimum of trouble. Some projectionists expose the paper (one for each machine, if required) and have it developed and fixed either by a photographer or by some projectionist who "hobbies" this sort of thing. The pattern then goes to a supply house where a machinist files the aperture to fit. What could be easier?

Requisites For Good Results

Of course, there are a few requisites for getting the desired results. You have doubtless noticed that the picture gets larger or smaller as the lens is moved during the focusing. When the image of the screen is thrown on the photographic paper, it (the image) will also get larger or smaller if the lens is moved. It is necessary to have the lens in the correct position before starting.

It won't do to focus the image on the sensitive paper, because all the time the focusing is going on the image is also being recorded on the paper, resulting in a fuzzy edge, or one that is indistinct, due to the varying size of the image. This is the wrong track anyway, because the aperture is not at the plane of focus when the picture is projected normally; it is at a slight distance behind the focal plane.

To those who have used only comparatively long-focal length lenses this may seem like stretching the point a bit too much; but others using short-focus lenses understand me perfectly. I use three-inch lenses. If, for any reason, the lens is disturbed, we dare not just throw the light on the screen and focus the outline of the aperture. We must thread up a film and actually project it in order to focus, otherwise it would be out considerably when the show started.

Not any sort of sensitive paper will do. It should have a smooth surface, as rough surfaces are too uneven to give a good pattern. A glossy paper of a medium grade is just the thing. Contact paper is somewhat too slow, requiring too long an exposure, although it was tried with good results when exposed

for five minutes. On the other hand, the enlarging paper is more sensitive, and requires a "safer" light than do the contact papers. I used an old orange-col-

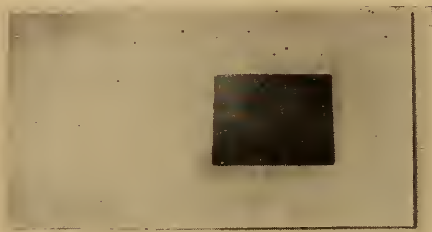


Figure 1

ored lamp for a safe light, but apparently it was not quite safe, as the paper fogged slightly.

To be sure of your safe light, when you get your enlarging paper also ask for some of the red paper that negatives are wrapped in (no charge for the red paper).

Shielding From Extraneous Light

The red paper is placed over the end of a flashlight and held in place by a rubber band. The paper must be so wrapped around the flashlight that no white light escapes. If no other light reaches the sensitive paper, everything will be alright. Slight fogging or other defects do not matter anyway (see Fig. 1). The black mass in the center is the shape and size of the desired aperture. The other darkened areas are due to reflections from the shiny metal parts in the mechanism and to extraneous light from other sources. Some of this could have been avoided by giving a shorter exposure. This was unnecessary, however, as the large black mass is well defined and serves the purpose perfectly.

After obtaining the paper do not open the package in ordinary light; use the flashlight with the red paper on the end. Cut the photographic paper to the same size as the aperture, that is, the outside of the aperture, so that the paper can be placed properly in the head. Exposure time is not critical. The pattern in Fig. 1 was exposed for one minute (using enlarging paper). The screen was about 26 feet in width and the light was from a Suprex-type lamp pulling 70 amps.

From this you can determine what exposure is required for your case. If your screen is smaller, the exposure may be shortened; if the screen is none too good in reflective power, double the exposure (for the same size). If you draw less current, again increase the exposure. The high-intensity arc without mirror will probably give about the same light when the current is double that of the mirror-type. One half to one minute exposure will undoubtedly give a satisfactory picture in 95% of the cases.

If you still have the front shutter, see that it is not in front of the lens when trying to photograph the screen. Oh, yes: the other machine with which the screen was illuminated was running at the time of exposure (no film in it, of course), which cuts the light in half. We never throw the light on the mechanism when it is standing still; the revolving rear shutter cuts the heat down that reaches the front plate and the lens.

Finishing Process Simple

It is easy to finish the paper yourself. Get a tube of MQ developer and a small package of hypo. Directions come with each. Use an orange lamp for a safelight, or the flashlight with the red paper. An important precaution is not to get hypo into the developer. Place the paper in the developer and watch the image appear, which it should do in about 30 seconds. Leave it in the solution until the black portion representing the aperture is good and black, or until it stops getting blacker. If this takes longer than 1½ to 2 minutes, the paper was under-exposed. Do not leave it in after the image is black enough, because the white part will start to "fog" or become discolored.

After development place the paper in the hypo solution for about five minutes, and then wash it in running water for ten minutes and allow it to dry. That is all. The print will probably not be permanent because the fixing and washing was not done thoroughly, but it will serve the purpose for which it was intended. Of course, by having someone else finish the print it will save you this bother.

By placing the aperture on the pattern you can see where filing is necessary. File the hole slightly larger than the pattern to allow the light to overlap onto the masking around the picture. This does not mean that the hole can be filed *very much* beyond what is indicated by the pattern. The linear enlargement is about 200 times when it reaches the screen; if an overlap of 2 inches is wanted around the screen, the hole can be filed only .01 inch larger all around. The total height of the aperture will be twice that much, or 1/50-inch larger than the pattern. The hole will also be 1/50-inch wider than the pattern. You need not abide by these limits, but can allow as much or as little as you choose. It is desirable, however, to allow some overlap, otherwise there will be blank margins on the screen.

Smooth Edges Minimize Scratches

A fine file should be used, otherwise the edge of the hole will be rough. While the rough outline will not be visible on the screen (this part will be on the masking) smooth edges will minimize film scratches. After the filing has been finished the whole thing is smoothed up with very fine emery cloth or with crocus cloth.

This procedure is not limited to the making of apertures, but will also help in making effect slides. About a year ago it was decided to put a border around the titles of feature pictures. Fig. 2 shows the slide finally used. The cock-eyed shape of the columns and top border was not accidental. The slide must look like this in our theatre so that it will be square and upright on the screen—due to the large picture, the comparatively short throw, and the fact that the effect machine is quite a bit off center. Imagine trying to dope out how the slide should look! With this method, however, it was no trouble at all.

A 4 x 5 inch negative plate (the size of our slides), was placed in the slide holder of the effect machine with the emulsion side toward the screen. A small ruby light was used to work with, all other lights being off. Then a couple of blankets were draped all around the plate and the lens, the blankets in such a position as not to hang down between the two and cut off part of the light. A hole was left in front of the lens, so the reflected light from the screen could get through to the plate. The blanket also must cover up the back of the plate and the space between it and the lens on the underneath side. Dark coverings must be used: a light cloth or blanket would reflect enough light to ruin the plate. The iris on the effect machine is closed. After the blankets are in position and the iris closed there is no need of darkness in the room.

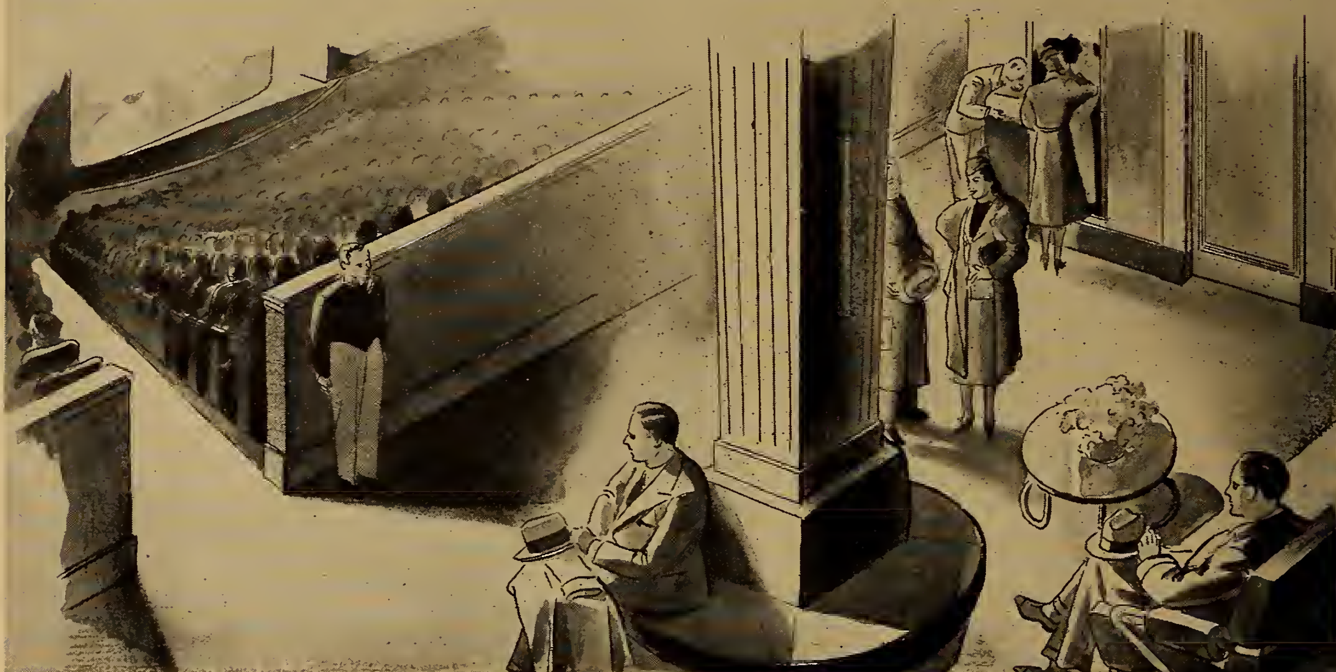
The masking around the screen is now opened up to the position it is to occupy when the effect is in use. The screen is now some 3 or 4 feet larger on the sides and the top than the picture itself would be. The entire front is flood-lighted and the iris opened so that the light from the entire screen is recorded on the plate. After this the iris is closed, the floodlight killed and the light from the picture machine thrown on the screen, *with the masking still in the open position.* The iris is again opened and a good long

Figure 2

exposure given. (Both exposures may be made at the same time if desired). The lights are killed, and the negative

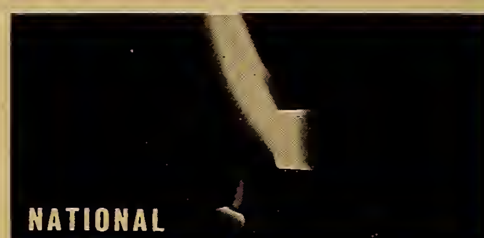
PROVIDE *Lighting*

COMPARABLE TO THE OTHER LUXURIES OF YOUR THEATRE

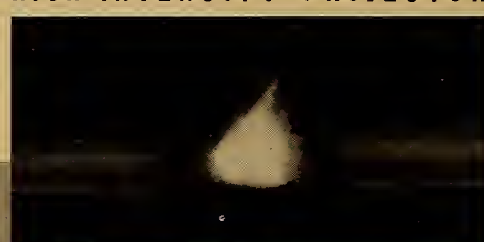


● Thousands of dollars are spent on the equipment of a motion picture theatre—a beautiful building, tasteful decorations, expensive carpets and the most comfortable seats. These luxuries call for lighting in keeping with other provisions for the pleasure and satisfaction of the patrons.

High Intensity Projection adds little to the cost of theatre operation but adds much to the quality of the picture thrown on the screen and to the comfort of incoming patrons.



HIGH INTENSITY PROJECTOR



AND NATIONAL SUPREX CARBONS

provide a steady, brilliant, snow-white light which gives clarity and depth to black and white productions and accurate tones in color projection. They also permit a level of general illumination adequate for comfortable vision.

USE NATIONAL PROJECTOR CARBONS

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide UCC and Carbon Corporation
CARBON SALES DIVISION, CLEVELAND, OHIO
General Offices: 30 East 42nd St., New York, N. Y.
Branch Sales Offices: New York Pittsburgh Chicago San Francisco

securely wrapped and taken to the dark room, where it is developed, fixed, and a print made.

Exposure Times Not Critical

No record was made of the exposure times, so these cannot be given here. They are not critical though, and an exposure that is far from correct will yield a usable negative. Fig. 3 is a print made from the negative. Note the practically white center, then a gray strip on the two sides and the top, surrounded by a black area. The black part is a picture of the masking around the screen; the white center the part of the screen occupied by the picture; the gray portion the part where the intended effect is to be.

There are only three shades in the print, so the exposures must be timed to produce three degrees of density in the negative. The gray could be darker and still be distinguishable from the black. Or, it could be lighter and still be seen against the white. Even if the gray were lighter and the white slightly darker, there would be enough difference between the two.

Consequently, we only have to get enough light on the gray portion to effect it lightly, because it will then be distinguishable from the black. Then the white is given *plenty* exposure so that there will be sufficient difference between it and the gray. From 10 to 20 seconds should do for the gray, and anything from a minute on up for the white.

Of course, the negative will be just the reverse of the print: the center will be black, the gray will still be some shade of gray, and the outer part should be white.

The negative is more sensitive than even the fastest paper, and an orange light will ruin it. Only a red light may be used. Do not use panchromatic plates, as they must be handled in total darkness. Cut film may be used instead of the plate, but the latter is easier to handle. Unless you have dabbled in photography, it will be best to have the finishing done outside, although it is not difficult. The same developer and hypo are used for the paper, only the light must be red.

It is not necessary to make a print and send it to the slide company, because the negative will do just as well. The slide company artist makes a drawing to fit the plate or the print. This drawing is then copied in a camera and a slide is made from the negative. When the slide is projected on the screen *it fits!*

Figure 3

As in the case of exposing for the aperture, it is important that the lens on the effect machine be in proper focus, and also the picture machine. If either one is out of focus the image on the plate will be blurred and it will be the wrong size.

I should mention that Figs. 2 and 3 are *not* identical. The slide in Fig. 2 was not made to fit the negative of Fig. 3. There were two *different* negatives made, and a slide made from each. Unfortunately, we no longer have the other slide, and, to boot, the other negative is also missing. Thus Figs. 2 and 3 are not mates, accounting for the difference between them, but they illustrate the idea.

The small white spots near the lower left corner of Fig. 3 were caused by the night light that was burning on the stage while the negative was exposed. The numerous irregular shaped lines on the left are from the same cause, and were recorded as the plate was being placed in the slide holder. This could have been prevented by closing the iris, or even the port hole.

COLOR, SOUND ADVANCES FEATURE YEAR'S TECHNICAL PROGRESS

Excerpts from Report of SMPE Progress Committee

Distinct improvement in color processes and in sound recording and reproduction marked technical progress during the past year, that was otherwise notable for the lack of new visual projection aids. Outstanding was the general introduction of the multi-cellular horn systems. New film stock, refinement of photographic technique and a sudden spurt of the 16 mm. reproducing field were other important developments. Greatly increased activity in the foreign field failed to result in any major contribution to the art.

THE greatest advances during the year seemed to take place in the field of sound recording and reproduction, the most interesting being the reproduction of push-pull recording and the use of ultra-violet light in both recording and printing operations. The year was noted for the introduction of a newer multi-cellular type of horn system for theatre use, insuring considerably improved sound reproduction quality.

PROFESSIONAL PHOTOGRAPHY

The fact that there have been no startling innovations in professional motion picture photography need not detract from the fact that the steady forward movement indicates a healthy condition and a tendency to greater permanency in the art. The year 1936 saw no new or upsetting inventions or processes, but a general improvement in both materials and technic in the several phases of the allied cinematographic arts.

Films and Emulsions.—During the past year numerous improvements have been made in the Kodachrome process and, in addition, a new type has been announced.[1] The latter is intended for use with artificial light, and is compensated for the difference in color between incandescent lamps and daylight, for which latter source the original Kodachrome film was balanced. Filters have been provided for interchangeably using either film with either source. At present either type of emulsion is available in each of the amateur substandard widths, 8- and 16-mm., and, in addition, the film is available for miniature still cameras in the 35-mm. width.

New Color-Film Process

Announcement has been made by Agfa of a new color-film based upon the Fischer process.[2] Several emulsions coated upon the same support contain components in the separate emulsions that react with the developing solution to produce colored images. Following the development of the colored images, the metallic silver is removed by a suitable bleach, thus increasing the transparency of the image.

In the field of black-and-white films for the substandard cameras, a new high-speed panchromatic film has been made available.[3]

A new infrared-sensitive negative film for professional production work has been made available.[4] This type of material, in conjunction with red filters, is used principally for special effects such as night photography in full daylight. Since the film is insensitive to yellow-green, only a light red or orange filter is necessary to hold back the ultra-violet and blue for night effects. This not only speeds up the possible exposure, but also

[1] *Amer. Cinemat.* (May, 1936), p. 218; (June, 1936), p. 264; (Sept., 1936), p. 396; (Nov., 1936), p. 483.

[2] "The New Agfa Process of Colour Photography," *Phot. Jour.* (Dec., 1936), p. 612.

[3] *Amer. Cinemat.* (June, 1936), p. 264.

[4] Meyer, H.: "Describing Agfa's Infrared Film", *Amer. Cinemat.* (May, 1936), p. 194.

produces a much better balanced and more realistic picture.

Cameras and Accessories.—Though an unblimped silent camera failed to make an appearance, progress may be reported in that field. A number of studios equipped themselves with *NC* Mitchell cameras, to be used in conjunction with very lightweight blimps. Two major studios gave the latest Debrie Super-parvo cameras practical tests in actual production with favorable results. But perhaps the most outstanding camera so far developed has been made by the 20th Century-Fox studios, under the supervision of Grover Laube. It has made eight feature productions, and plans are now under way for the manufacture of several of them for use in the Fox studio.

Aside from its being satisfactorily silent unblimped, it provides a greater shutter opening than is commonly used; has an improved optical system which speeds up its use; the finder is not only more brilliant, but, due to its closeness to the shooting lens, parallax has been virtually eliminated. Its movement, with a 200-degree shutter opening, and very fast acceleration and deceleration, permits the film to be perfectly at rest during exposure, increasing greatly the definition of the image. It is undoubtedly a big step forward in camera design.

Columbia studios developed a direct motor drive for high-speed camera work, remotely controlled by a rheostat, providing a smooth movement from 24 to 192 frames per second. This eliminates the gear-box with its attendant unsteadiness. The studio also developed a variable diffusing device, or, rather, improved several existing devices, wherein the diffusion may be varied as needed, particularly in moving from a long shot to a close-up, where constant diffusion is undesirable.

Camera, Color Improvements

Camera Lenses.—Hal Mohr reported a useful method of achieving greater depth of field in photography[5]. It consists in using a lens so mounted that it can be rotated about its nodal point, and setting the lens angle for each shot so that the near and far objects are in best focus on the film. The effect is exactly the same as if the camera were equipped with a swing-back.

Several articles have appeared during the year that are of fundamental interest to designers of optical equipment. Klughardt and Otto give measurements of the actual light transmission through photographic lenses[6] and show that the losses in modern high-aperture lenses are very great.

Color.—In the color field, no doubt Technicolor, with their several pictures such as *Ramona* and *Garden of Allah*, showed the most pronounced improvement in the rendering of natural color and make-up. However, Cinecolor, Magnacolor, Cosmocolor, Dufaycolor, Dunning, Keller-Dorian, and others came to the fore with strong claims. The quality of some of their work is such that it is safe to predict that a very strong color influence will be felt during the coming year. The projection of color backgrounds, and the painting of such backgrounds and the consequent matching of them photographically, has been done very successfully, and will further the cause of color work immensely.

The improvements in Kodachrome[2] and the impending introduction of the new three-color process by Agfa[2] lends active interest to color photography and augurs well for the future of color in the cinematographic field.

Sixteen-mm. projectors have been continually improved so that now the quality of both picture and sound compares favorably with that of 35-mm. equipment. In the meantime film manufacturers also have improved their products and have kept abreast of the increased demand for finer-grained films, made necessary by the increased size of screen images.

These improvements are opening new fields to 16-mm. film, which is rapidly

(*Continued on page* 28)

SEEK UNIFORM EXCHANGE PRACTICE

Excerpt From S. M. P. E. Exchange Committee Report

THE question of uniformity of exchange practice and technic have been receiving the close attention of the Committee for some time, particularly with reference to the relation between the laboratory phase and the projection phase, referring to the state in which film is received by the exchanges from the laboratories and sent by the exchanges to and received from the theatres. In this connection, it is important to note that the Chairman of the Projection Committee, Harry Rubin, has been made a member of this Committee.

Considerable attention has been given to the subject of rewinding films in exchanges and the manner of making patches. It was the decision of the Committee that in the interests of uniformity it would be best to supply films to the theatres wound with the heads out, despite the fact that this would lead to a slight problem in Chicago, which city requires that projectionists use 14-inch reels, making it necessary to rewind the film from the reels supplied by the exchanges. Exception must therefore be made in the Chicago area, in supplying the films wound with the tails out.

Steps have been taken to improve the uniformity of printed material accompanying films shipped out by exchanges, in respect to reelbands, labels, *etc.*, the idea being to make the information contained thereon more uniform and explicit.

A plan has been formulated to prepare an instruction booklet, under the auspices of the Committee, for distribution among exchanges, which would describe in more or less detail the proper way to inspect and handle film. Such a booklet was prepared some time ago for use in Paramount exchanges, but the plan is to prepare a more up-to-date and complete guide for the exchange personnel than was available in the Paramount booklet.

Steps have been taken also to draw up plans for an ideal exchange, probably in a form somewhat similar to the plans drawn up by the Projection Committee for motion picture projection rooms. These plans will describe, in general terms, the recommended construction of the exchange; specifications for the equipment; and proper method of operation, including housekeeping and general maintenance. The plans will also contain general information relating to the problems of supervision, working conditions, the advantages of avoiding confusion and noise, the importance of adequate light and ventilation, cleanliness, *etc.*

Preparing Demonstration Film

Another project that will undoubtedly turn out to be of great importance to the exchange branch of the industry is that of preparing a demonstration film, under the supervision of this Committee, which would show the proper procedure to be followed in inspecting and handling film in the exchanges. This film will complement the instructional booklet described above. The scenario for the film is now being prepared, and it is probable that shooting will begin within the next month or so. The purpose would be to provide prints of the film to exchanges, as needed, for showing at their various branches in order to instruct their employees.

How often such showings will be necessary will, of course, depend upon the needs of the exchanges and upon the turn-over of their personnel. The film will tell a running story, the comments being made either in the form of a running narrative or as remarks by the various actors in the picture.

---

[5] *Amer. Cinemat.*, 17 (Sept., 1936), p. 370.
[6] *Photographische Industrie*, 34 (May 27, 1936), p. 608.

COMMON AND UNCOMMON TERMS IN SOUND PICTURE REPRODUCTION

By *FRANK T. JAMEY, JR.*

Repeated and insistent requests from readers for clarification of various terms employed in articles in I. P.—the meaning of many of which is assertedly so obscure as to militate against a full understanding of the information conveyed—prompted the presentation of a series of articles, this being the first, which will endeavor to cover by easy stages and in detail the meaning of those terms cited by the craft generally as being unfamiliar.

For the more advanced students of the art these articles will serve admirably as a brush-up, while at the same time rendering a distinct service to their less well-informed brother craftsmen.—Editor.

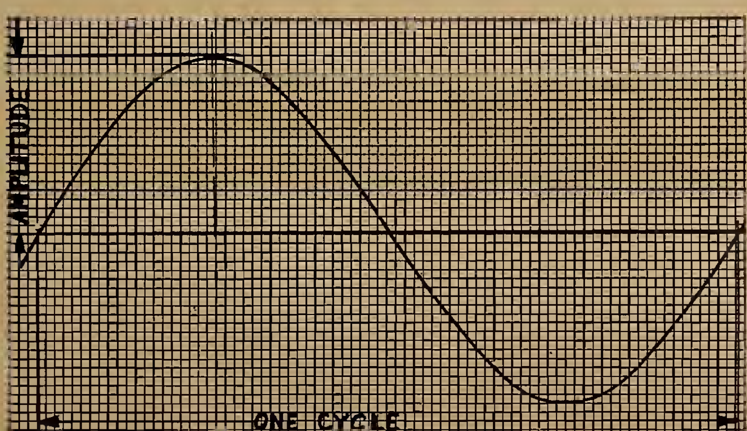
TEN years ago sound was commercially added to the motion picture. Since then a great many improvements have been made in this field with the result that today high-quality sound motion pictures are being presented to theatre audiences. The introduction of sound, however, meant the addition of a rather complicated and technical subject to the scope of those already familiar with the then existing motion picture. For this reason it is wise to review some of the fundamentals about sound in order to best appreciate both the terms used constantly today in the theatre by technicians, and the problems which exist.

Sound can be considered as a series of vibrations of the air of such frequency, or pitch, that it is audible to the human ear. Sound is produced when air is set into vibration by any means whatsoever, usually by a vibrating object which is in contact with the air. There are certain characteristics of sound of great importance which determine the frequency (or pitch), the tone and the loudness.

Comprehension of the term *frequency* is first important to best understand the other factors mentioned. Any one of a series of variations, starting at one condition and returning once to the same condition is called a *cycle.* As an example of this, if we fix our attention at some point on the surface of water in which waves exist, we would notice that at one particular point the water will rise and fall at regular intervals. At the time at which the wave is at its maximum height the water begins to drop, and continues until a trough is formed, when it rises again to its maximum height. Therefore, if we notice all the variations of height through which one point on the surface of the water goes in the formation of a wave, we will have witnessed a "cycle" of wave motion. Sound waves are similar in nature.

The number of complete cycles a wave goes through in a definite interval of time is called the *frequency.* Because in sound the number of waves is large, we deal entirely in terms of *cycles per second.* Pitch of sound is directly proportional to frequency. The higher the note on the keyboard, the higher the frequency.

There are any number of examples of this, such as the exhaust of a motor or the noise caused by any rotating machinery. We know that as the speed of the motor increases the pitch of the sound of the exhaust or the motor itself increases in direct proportion.



Wave form of fundamental frequency

Thinking again of the waves on the water, the *amplitude* on which the intensity of the sound depends is the distance of the wave from the points of rest to the extreme displacement in either direction. If the waves in the water have been caused by dropping a pebble in still water, waves of a certain size are created. If a rock is dropped in, much larger waves are caused—larger in the sense of higher waves, which is what governs intensity.

Loudness is the magnitude of the subjective response to the intensity of the sound. There is no absolute loudness of a sound but only a difference in the loudness of two sounds. The sensation of loudness depends upon both the intensity and the frequency of the sound. Loudness is generally measured in terms of *decibels.* The decibel scale of loudness is based on zero representing a loudness of a sound that is barely audible, and the loudness of any sound is measured in decibels above this threshold of audibility.

Overtones or Harmonics

The tone of the sound is determined by the combination of the pitches. The note caused by the vibration of a body in air does not simply consist of one frequency. In addition to the *fundamental* or "pitch" frequency, sounds so created also include other frequencies called "overtones" or *harmonics.* These frequencies are of less intensity and are multiples of the fundamental frequency. They are caused by vibrations of segments of the vibrating body which cause sounds with frequencies of a higher pitch than the fundamental frequency. The tonal quality of a sound depends on the frequencies and the relative intensities of the overtones present.

A violin string which is plucked and thus set in motion creates a fundamental frequency from the motion of the entire string, but segments of the string will also vibrate in a different relation than the entire string, creating overtones with frequencies which are multiples of the fundamental frequency and of less intensity.

We all know that if a musician plays middle C on a flute and on an oboe, two wind instruments of comparable size, the notes sound quite different. The funda-

mental frequency (256 cycles per second) is identical but the combination and intensity of the overtones is quite different. It can be thus understood that overtones give distinguishing character to the source of the sound.

Broadly speaking, the objective of any mechanical recording and reproducing system, or of any sound transmission system, is to create reproduced sound precisely similar to that originally created. We can now easily comprehend the necessity for a system that introduces no losses or additional sounds. Such a system needs to adequately care for all of the fundamental frequencies and overtones uniformly and with *proper relative intensities.*

The fundamental frequencies of voices, musical instruments and common noises lie in the range of approximately 40 to 5,000 cycles per second. The overtones then lie in the range of approximately 80 cycles per second upward. The range of frequencies which the average person can hear is from about 20 to 17,000 cycles per second, but a comparatively large amount of sound energy is required before the ear can detect sound of extremely low or extremely high frequencies. The ear is most sensitive to changes of pitch and changes of intensity of sound in this same band of frequencies. The ear is most sensitive to sound generally at about 4,000 cycles.

To properly accomplish the objective mentioned, it is desirable that such systems accommodate frequency ranges from 40 to 10,000 cycles per second to insure the easy distinction of each sound source. It must at the same time be able to clearly bring to the auditor's ears sound with its proper relative intensities, which means a range of about 80 decibels. We are not able here to discuss the problems involved in designing such systems.

Acoustics a Vital Factor

There are a number of problems, however, directly connected with sound which are of interest. Acoustics is one of the major problems. This relates to the recording studio as well as the theatre. An illusion is desirable which permits the theatre auditor to imagine himself right in the studio. Such an auditor would probably select a place in the studio where he would hear the sound best, which would no doubt be a position where mostly direct, and a minimum of reflected, waves would reach his ears. This means that the very sensitive microphone must then be placed so that the same sound (and only that sound) that reaches the ears is picked up by the microphone.

This is not as simple as it sounds, because of the greater sensitivity of the microphone and the fact that the position of the microphone needs also to be governed by certain camera position requirements and also by noisy lamps which may have to be used for illuminating the set and the characters. Considerable study has been made of studio acoustics to prevent changing the character of the sound before it reaches the microphone.

Another problem results from the desire to cause the illusion of creating the sound in a large concert hall or opera house when in reality it is in a small studio. By controlling the acoustics of the studio such an illusion may be created. In the theatre, of course, the acoustic problem arises as a result of the necessity of directing sound with equal quality to each and every seat. Most theatres were built for silent motion pictures and did not lend themselves to sound movies.

In studying this problem, the goal was to attain at least intelligible speech. Thus the problem is complicated by the necessity of absorbing certain of the frequencies which might make speech unintelligible, and not affecting other frequencies which might affect the quality of music. Too often, theatres are acoustically treated without regard to the particular frequencies which are absorbed.

These complications arise because flat, hard surfaces reflect and certain materials absorb, sounds of different frequencies with a varying degree. Thus, recognizing the desirability of preserving as many of the higher frequencies as possible to insure high quality of sound by permitting as many overtones as possible to reach the auditors' ears, and also the fact that reflection of the lower frequencies are the ones affecting the clarity of speech, it is often best to treat the auditorium with some material that absorbs the lower frequencies to a greater degree than the higher ones. Each case is an individual problem requiring expert study.

Another interesting problem with regard to sound concerns the personal likes and dislikes of auditors. Repeating what we mentioned earlier, the theoretical objective is to bring to the ears of the auditor the sound as originally created. However, there are many people who desire, and often insist upon hearing, many more low-frequency sounds than were originally created. This tends to unbalance the character of the reproduced sound.

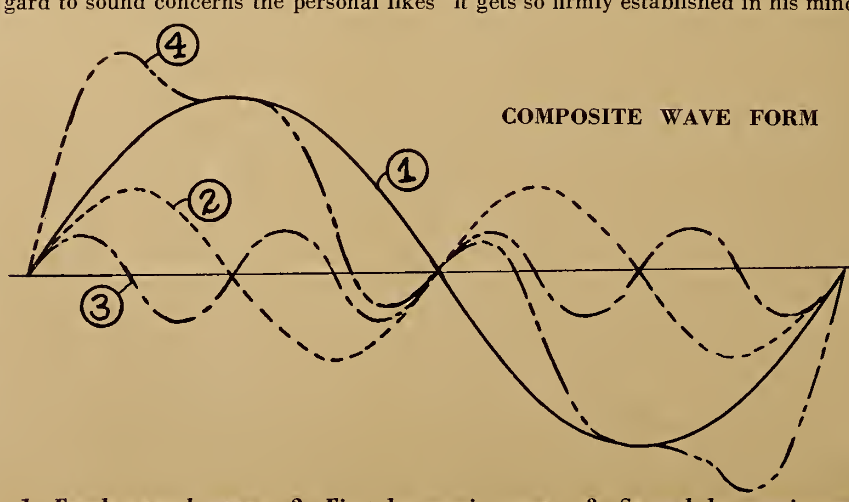
Personal Preferences Govern

This peculiar condition also exists in the radio and phonograph field. It is partly due to the fact that the lower frequencies are more pleasant to the ear; while the higher frequencies seem to be sharp and grate upon the ear. In the case of radio, static interference is generally in the range of the higher frequencies; and in the case of the phonograph, the needle scratch, which has been very much reduced in recent years but not entirely eliminated, is likewise in the range of the higher frequencies. This may also be a cause for the desire to eliminate higher frequencies and increase lower ones.

That is theoretically wrong unless it is necessary in order to maintain clarity. The excessive low-frequency response soon becomes very annoying, and one finds it a relief on the ears to have it eliminated. If people in general desire music with greater low frequencies, then they should prevail upon the orchestra conductors to play more low frequencies originally. Mechanical recorders and reproducers or transmission systems should not be called upon to artificially change the character of the sound.

The determination of sound quality is not easy, because it is so difficult to carry in one's mind a definite impression of any particular quality, as a means of comparison. Direct comparison is generally out of the question. It is a fact that if anyone listens to any quality of sound long enough he gets so used to it—that is, it gets so firmly established in his mind as

COMPOSITE WAVE FORM



1, Fundamental wave. 2, First harmonic wave. 3, Second harmonic wave. 4, Total composite wave.

a standard for comparison—that any other sound quality, even much better, appears to be undesirable. As a result of the study of the nature of sound in the beginning of this article, it is possible, with the aid of a few rules, to analyze sound quality.

First of all, one must determine whether all the sounds which he can see being created in the photograph are heard. Then, are they natural? Don't use the ordinary radio or phonograph as a standard, because their frequency response, for many reasons, still is limited pretty much to the range of the fundamental frequencies. But many of you have heard actors and actresses in person and know their voices. Can they be recognized in the picture, without a determined effort, by watching lip motion?

Can you determine just how many instruments are being played at any one time? If not, the higher overtones must be missing. Without them the distinguishing character of the sources of the sounds is gone. Can you hear the bass instruments and, also, particularly the cymbals, wire brushes and triangles? If so, then quite a wide range of frequencies is being reproduced.

One very interesting fact is that the reproduction of the overtones lends presence to the sound—that is, makes it seem as if the creators are right in the theatre. This also creates the illusion of the sound emanating right from the surface of the picture sheet, which is desirable. If it seems to be coming from way back of the screen, few higher frequencies are heard. Application of these simple rules will often permit the average auditor to determine for himself the degree of quality of the sound.

And so we see that sound is a rather complicated subject to which considerable attention must be given for a proper appreciation and understanding. Most projectionists know a lot about visual projection problems but not too much about the nature of sound. A better appreciation of these problems by them will aid materially the progress of the art.

REPAIRS *vs.* OBSOLESCENCE

By *H. H. DAWES*

GENERAL RADIO COMPANY, CAMBRIDGE, MASS.

Few industries equal, and none surpass, that of motion pictures in repairing old equipment rather than purchasing new units. Motion picture equipment tolerances, particularly in the reproduction branch, are among the narrowest extent—yet repair jobs on units 15 or more years old are common. The appended article, while dealing with radio products, is so applicable to current practice in the projection field as to add to rather than detract from its original high value.—ED.

OUR service department, through which are handled all customer complaints, repairs, exchanges, and adjustments, is often called upon to repair and rebuild obsolete equipment. Experience has shown that misunderstandings between manufacturer and customer arise more often with obsolete instruments than with current models. The two major points of disagreement are: (1) cost of repairs and (2) instrument performance *after repairs are made!*

Since each instrument returned for reconditioning must receive individual attention, the work must be handled in much the same way as a special manufacturing job. Consequently, the amount of supervision required per instrument is considerably more than that necessary in regularly scheduled production.

An analysis of the performance characteristics must be made as well as a schedule of mechanical repairs. All badly worn or defective parts must be replaced, resistance elements readjusted, and the remainder of the assembly thoroughly cleaned and tightened mechanically. This involves an operating check on nearly all component parts, and when these are found defective it is often difficult to find replacements, particularly if the instrument has been obsolete for any considerable period.

Individual Jobs Expensive

Parts which are of our own manufacture may not be in stock. While these can be made, the operation is necessarily costly because they were originally made in large quantities. Parts and materials supplied by other manufacturers may no longer be available, which necessitates finding satisfactory substitutes or making minor changes in the design of the instrument.

After all repair operations have been performed, a complete operating test and calibration must be made in our testing laboratory. Here again it is uneconomical to handle the instruments individually, since all normal production work is done in quantity lots.

Electrical design and production methods are constantly improving. As a result, many labor operations performed on obsolete instruments are less efficiently performed than those on newer products. This is particularly true of such items as the Type 102 Decade-Resistance Box, for example, in which certain of the cards were wound with resistance wire having a high temperature coefficient. Readjusting resistors in these cards consumes a considerable amount of time because the wire is raised in temperature whenever a soldering iron is applied to it. The repair of these resistance boxes is often not merely a matter of readjusting a few resistors, but one of replacing most of the resistance cards in the box. Since the resistance cards represent the greater part of the original cost of the instrument, repair costs are correspondingly high.

A cost analysis of reconditioning operations on a number of obsolete instruments shows that the average repair prices are approximately as follows:

Original Cost of Instrument	*Maximum Repair Charge*
Less than $50.00	75% of list price
Between $50.00 and $100	65% of list price
Between $100 and $200	50% of list price
Above $200	33% of list price

These are only approximate prices and the exact charge is, of course, dependent upon the age and the condition of the instrument. From these figures, however, it will be realized that in many instances the repair costs approach the list price of a new instrument which has replaced the model submitted for repair. Because of this it is often less expensive, or at least very little more so, if the instrument is replaced by a newer model.

Performance After Repair

In addition to the cost, the performance to be obtained from the repaired equipment should be carefully considered. It should be obvious that the maximum performance to be expected from a reconditioned instrument is only that obtainable when the instrument was originally sold. Usually this is considerably inferior to that obtainable from instruments of more recent design. In other words, a complete reconditioning of the Type 513-B Beat-Frequency Oscillator will by no means make it equal in performance to the newer Type 713-A Beat-Frequency Oscillator.

As an element of the total cost of repairs, therefore, the performance to be expected from the repaired instrument is important.

If we offered for sale, at its original price of $100, a brand-new Type 102-M Decade-Resistance Box which was manufactured between 1920 and 1931, its purchase could not be justified, because a Type 602-M Decade-Resistance Box, which has far better characteristics and general performance, can be purchased new for $70. Yet the cost of repairing a Type 102-M Box may be well in excess of $50.

THE NEON TUBE OSCILLOSCOPE AS A PRECISION SERVICING INSTRUMENT

By *THEODORE P. HOVER*
MEMBER, PROJECTIONIST LOCAL UNION 349, LIMA, OHIO

Presenting the first of two articles on an equipment which, while not new to I. P. readers, has so recently been introduced to the sound picture field as to warrant a detailed statement anent its applicability to projection work. The author has not only used this instrument in practical projection work but has constructed them in their entirety—thus assuring an authoritative presentation.—*Editor.*

I.

PROJECTIONISTS must have not only a mastery of the art of projection but also a wide knowledge of mechanics, optics, and electricity. This means that their tool kits must contain tools and instruments dealing with these three branches. Unfortunately the rapid development of sound pictures has not been followed with equal speed by the development of satisfactory tools and maintenance equipment. Before sound pictures most modern projectionists had sufficient tools for average mechanical and electrical repairs. Complicated sound equipment necessitated many additions to the projectionist's tool kit.

Recently the market has been flooded with "aids" to the projectionist ranging from projection schools to complicated testing equipment. The schools guarantee to place their "graduates" in Radio City; and the test equipment, it is claimed, will detect all faults, from a leaky roof to rats in the basement. Unfortunately, less than 1% of this equipment is directly applicable to projection room service.

One instrument, however, has been of outstanding assistance to the practical projectionist—the neon tube ("Neobeam") oscilloscope.

Many improvements have been made in the original instrument, resulting in a real service tool for the maintenance and repair of both mechanical and electrical equipment in the projection room (Fig. 1). Hardly a week passes but someone in our organization discovers a new use for the oscilloscope.

No attempt will be made here to give a course in projection or to describe the theory of operation of the neon tube oscilloscope. Ample information on the latter appears in the instruction book furnished with the instrument. It is well to warn the prospective trouble-shooter of two important points involved in the satisfactory maintenance of sound equipment: (1) the projectionist must be familiar with *both* the service equipment and sound equipment, (hook-ups, wiring diagrams, etc.) and (2) he must be absolutely sure that the fault is actually in the sound equipment, and not one imagined by the manager or existing in the film itself. Current of film inspection and maintenance practices make the latter fact possible.

Two Most Common Troubles

The two most common defects in projected sound come under the headings of distortion and modulation. Distortion is addition of parasitic signals to the original sound signals. Modulation most frequently occurs in the sound mechanism itself and its source is usually mechanical; while distortion may enter anywhere, from the optical system to the speaker itself.

One of the most elusive troubles is hum, which frequently creeps into a sound system after one to two years, there are many speaker installations which use rectifiers, both dry disc and tube, which supply field current with no filter system whatever. The result is that hum is always present in the speakers. This is particularly objectionable where directional horns and baffles are used, as this hum will be projected out into the auditorium and frequently interferes with the clarity of speech in certain groups of seats directly in line with the center of the horn.

To thoroughly check this defect, the oscilloscope should be taken back stage and hooked to the voice coil of the speaker unit. The amplifier, of course, should be off. With the input switch set at 2 volts, the field supply unit should be turned on and the sensitivity control should be opened full. The presence of a clear cut 60-cycle oscillogram covering the entire screen is ample proof that there is insufficient filtering (see Fig. 2).

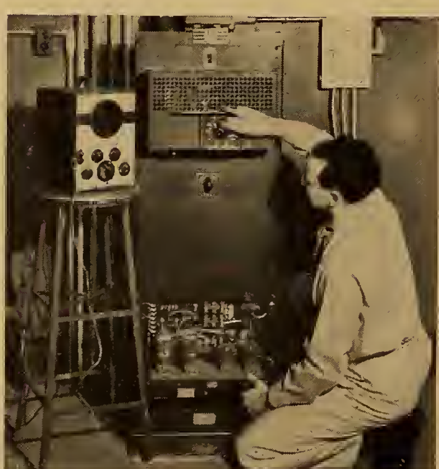


FIGURE 1
Oscilloscope set-up for checking amplifier output

Of course, in the cases where the field of the speaker serves as a choke for the amplifier, it will be necessary to trace the trouble back to the projection room. When the field supply is obtained from a high-voltage rectifier tube (usually mounted near the speaker), the hum may be reduced by the addition of a new filter condenser, if there is one, or by the addition of one, if the system was built without this unit. In high-voltage units using 80's, 82's 5Z3's, *etc.*, as rectifiers, an 8-mfd., 500-volt condenser placed across the output of the field supply will usually reduce the hum sufficiently.

In the case of dry disc rectifiers, or generators, usually of low voltage, a 2000-mfd. filter condenser should be placed across the field supply. It should be recalled that electrolytic condensers have polarities and the black lead must always go to the ground. Failure to hook them up in this manner will result in a short-circuit of the current supply and destruction of either condenser or transformers and tubes.

When checking the field supply, the oscilloscope should be watched carefully as the replacement or new condenser is connected into place.

Usually the hum oscillogram will immediately drop or disappear entirely. A final check may be made by short-circuiting the voice coil leads at the terminal block on the speaker. With these leads shorted, field supply on, and, of course, sound amplifier off, there should be no hum, or only a very slight hum coming from the speaker. If this hum can be heard six feet from the speaker, additional filtering should be placed (see Fig. 3).

Another source of hum, often overlooked, is caused by placing heavy filter chokes too near transformer components of the sound amplifier. These chokes, when in the power supply unit of the amplifier, are usually the problem of the

amplifier engineer; but in recent years a number of battery eliminators have been installed to supply exciter lamp and low-voltage field supplies. These eliminators frequently incorporate massive chokes which have a magnetic field extending in all directions from the cabinets, and if these cabinets are placed too close to the sound amplifier or photocell leads, an abnormal hum is sure to be picked up and amplified. This can only be cured by proper isolation of these chokes.

It should be remembered that electrolytic condensers lose their filtering ability with age, which action is greatly accelerated by abnormal heat, too often present, due to close proximity of transformers and tubes. Any projection room amplifier, in operation for two years or more, which makes use of electrolytic condensers in any form, should have a condenser check-up at least every three months. The abnormal temperatures existing in most projection rooms rapidly dry out the "dope" in the condensers changing the capacity and permitting hum or unbalanced conditions to exist in the amplifier.

In a majority of cases, this insufficient filtering is easy to check-up on, because it will be easily noticeable in the oscilloscope, which should be hooked to the out-put leads of the amplifier. The exciter lamps should be turned off and the volume control set normal. The presence of a heavy hum oscillogram indicates either defective condensers or improper placement of transformer components. In a properly built amplifier, the latter is improbable. For amplifiers using a 500-ohm out-put, the 200-volt tap on the oscilloscope switch should be used, while for voice coil out-puts the 2-volt setting is better.

A Few Case Histories

(1) A complete sound outfit which had been operating satisfactorily was moved from one theatre to another. Great care was exercised in the installation; but when it was hooked up a loud hum came from the speakers—almost as loud, in fact, as the sound itself. In checking this, the oscilloscope was connected to a phone plug which was plugged into the monitor jack on the amplifier. Little or no hum was detected. This of course, immediately isolated the trouble to the speaker setup. Since the monitor horn also hummed, it was obvious that the trouble had to be something that was common to all speakers.

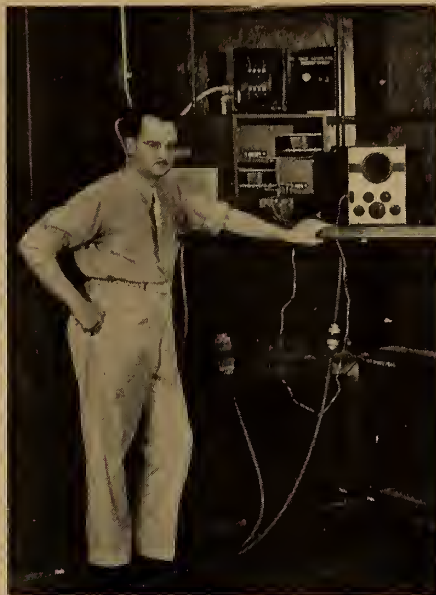


FIGURE 3
Set-up to check speaker hum

A thorough check showed that a large field supply unit had been shipped in an inverted position and all the liquid had run out of the electrolytics. New condensers were installed and the hum subsided.

(2.) A portable sound outfit used by a high school functioned perfectly in every room in the building but one—the physics laboratory, located in the basement. When used in this room, and the volume control opened to normal setting, a violent hum issued from the speaker. Obviously, we had to look outside the installation for the trouble, suspecting some unusual interference. An exploring coil, which in our case was made from an old 50-turn radio frequency transformer taken from a junk radio, was hooked to the in-put of the oscilloscope. An extension was placed on the line cord of the oscilloscope which was carried to different positions in the room.

A brilliant a. c. oscillogram was registered when the instrument was carried within four or five feet of one of the walls which happened to be near where the projectors had been used. Investigation showed that on the other side of the brick wall was located a 200-horse power capacitor and 2200-volt transformer bank which supplied the entire block with light and power. Even the careful shielding of the amplifier was not proof against the enormous magnetic field generated by this equipment. The trouble was overcome by placing the screen in one corner of the room and the projector in the opposite corner, away from the transformer.

Next to the elimination of hum, setting the sound optical system is of great importance (Fig. 4). This operation is by no means complicated, but requires patience, common sense and accuracy. Certainly it does not warrant the mystery and secrecy with which it has been ininvested by some manufacturers.

To set the optical system, it will be necessary to have a strip or frequency loop calibrated in 7, 8 or 9000 cycles; even 6000 cycles will do. The oscilloscope should be hooked into the circuit as near the p.e. cell as possible. In some outfits using the transformer-coupled p. e. cell it is possible to hook the shielded leads from the oscilloscope directly to the line terminals of the transformer. With some installations, the shield of the flexible lead should be grounded and the center, or hot wire, can be connected directly to the grid of the first tube. With high-level cells, the high-gain amplifier built into the oscilloscope will furnish enough amplification to get an accurate oscillogram. It should be understood that the p. e. cell should not be disconnected from the amplifier circuit, as this would remove the polarizing voltage.

Wherever possible, the oscilloscope should be connected as near the cell as possible, in order to avoid filter networks in the amplifier, which might tend to reduce or completely cut off the 9000-cycle signal. If a head- or pre-amplifier is used, connect to the line or output terminals; and where a voltage amplifier is used to drive a power stage, connect the oscilloscope to the output of the voltage amplifier.

Many different methods can be used in setting optical systems. We have used the two described herein with considerable success. It should be pointed out that for setting optical systems which do not have a micrometer adjustment

FIGURE 2

A *Sine wave as seen on 60-cycle oscillogram*

B *Voice wave: singing with throat tense*

C *Same note as B, with throat relaxed*

D *Noise oscillogram*

built in, it is necessary to use some type of adjusting tool. Many projectionists have successfully built adjusting instruments out of odds and ends found in the junk box, using a fine thread machine or thumb screw as an adjusting medium.

In emergency cases where we cannot fit on one of our homemade clamps with a micrometer adjustment, we have found that snapping a spring type wooden clothespin around the lens barrel will provide enough leverage to twist, and also slide back and forth, the optical system.

We will review briefly the fact that a 9000-cycle loop has a sound track made up of thousands of equally spaced light and dark photographic lines running exactly at right angles to the length of the film. There are 9000 of these lines to each 1½ foot of film, which is projected at the rate of 90 feet a minute. When the optical system is in perfect focus, the beam of light will be cut off completely as each line passes down along the aperture plate; in other words, when in perfect focus, there will be 9000 white flashes per second projected on to the p. e. cell.

If the projector system is out of focus, more than 1 dark line will be cut by the beam, which will completely destroy the high-frequency response and give a characteristic mushy sound to both voice and music. It is also important that the beam of light projected by the optical system be exactly parallel with the lines on the film, because if this line cuts the film at a diagonal, the result will be the same as if more than one line was cut at a time.

With outfits which have the optical system held in place with slots or keys, no attention need be paid to this last item as this system always has the light beam parallel with the frequency lines. However, a majority of systems do not have this feature.

We use the following method for setting optical systems where d. c. is available at the exciter lamp. [A different method should be used where a. c. is used on the exciter lamp, as the fluctuation of the light source on a. c. must be considered when reading the oscillogram.] After the oscilloscope is connected, the frequency loop should be threaded through the sound mechanism. Many of the newer installations permit the use of a very short frequency loop which need not be threaded through the projector mechanism at all.

The exciter lamp should be shielded and the projection room lights turned out in order to get the best possible view of the oscillogram. The scanning mirror speed is opened full, and the projector is run at normal speed. One should avoid damage to the loop which can eas-

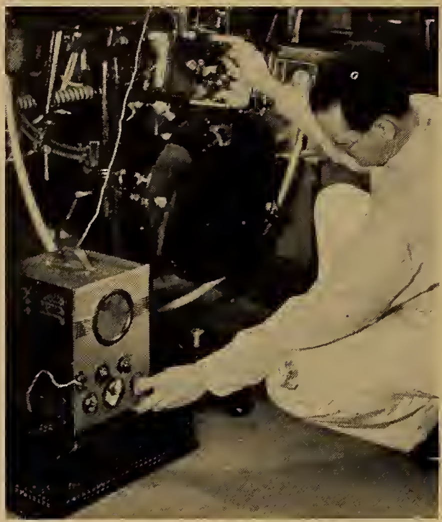


FIGURE 4
Checking the optical system

ily result if it catches on various projections. The set screw holding the optical system should then be loosened, and if no micrometer adjustment or clamp is available, the clothespin or wooden fuse tong is snapped on the barrel of the optical system. The beam should be focused down as far as possible with the naked eye.

The oscillogram will probably resemble a straight band of light, which should be adjusted with the sensitivity control so that it covers about three-fourths of the scanning mirror. In order to line the slit image up parallel with the frequency lines, carefully rotate the lens barrel until the individual frequency lines begin to spread out from the band on the oscillogram. It should be remembered that this slit image projected by the optical system should never be less than .001, and for high fidelity results is .0008 inches high. For this reason, patience is required in order to get a clear-cut and sharp-toothed oscillogram.

Holding this position, the optical system should be cautiously slid forward or backward. This change will immediately be registered by an increase or decrease in the height of the oscillogram. The optical system will be in perfect focus and alignment when the oscillogram is at its highest and the saw-tooth effect is at its sharpest and clearest. When this point is reached the optical system should be locked into place, if possible, without moving the lens barrel.

When d. c. is not available, another method has been used to set the system. The oscilloscope is hooked up in the same way. The frequency loop is hooked up in the same manner, but the motor is not run. After a few turns of the motor by hand, in order to take up any slack in the film, the exciter lamp is turned on. The optical system is focused as nearly as possible by sight, and the projector motor is carefully turned until the light passes through the light part between two of the dark frequency lines. This light, modulated by the a. c. supply and picked up by the p. e. cell, will give a distinct 60-cycle oscillogram.

As in the other method, the sensitivity control is used so that this oscillogram covers about three-fourths of the mirror, and then the scanning motor speed is varied to bring the image at or near a stationary position, (not important, but we found it easier to work). The projector is then very cautiously turned (often better results can be had by taking hold of the sound shaft itself and moving it slightly). This requires great care, and close attention must be given the oscillogram. With patience, it will be found that the lens can be moved so that when the slightest tension is applied to the sprocket, the a. c. oscillogram will go from a maximum to a minimum reading.

The theory behind this, of course, is simple. When the lens is in focus, the slit image being the same height as the frequency line, as the dark line is pulled down it will completely cut off the light

PHOTOCELL SENSITIVITY CHANGE URGED

SOUND picture engineers are urged to develop a new photocell as an aid to proper rendition of color films in the current report of the Color Committee of the S.M.P.E. An excerpt therefrom follows:

"The use in the projector of a photoelectric cell such as the caesium cell, having most of its sensitivity outside the region of the visible spectrum, requires that color processes deal not only with the visible spectrum but also with the added region in which the photocell is sensitive. This imposes a further burden upon those working in color. Their problems would be considerably simplified were the sensitivity of the photocell confined to the visible spectrum. The sound men themselves would gain an advantage also in such a case, due to a simplification of the design and accurate focus setting of the optical system in the reproducer.

We do not mean in any way to urge a return to the potassium cell used prior to the advent of the caesium cell, but rather to urge the search for a cell having all the advantages of the caesium cell but with its principal sensitivity within the visible range. In other words, the Color Committee believes that the ideal photocell for the projector has not yet been developed and it would urge the sound men to seek it."

from the p. e. cell, and the oscillogram will drop to zero or minimum. As the film is moved forward slightly, the light area of the frequency strip will come before the slit image, and the oscillogram will rise to a maximum. With the clear space before the optical system, the slit image can be easily adjusted parallel to the frequency lines; because if the image is even slightly diagonal to the frequency lines, it will be immediately shown by a decrease the width of the oscillogram, since the lapping over of the light beam at each end will decrease the amount of light passing between the frequency lines and, of course, will be registered on the oscilloscope.

Both of these methods require patience and care, but are well worth the effort. We have found that this is a "two men" operation, if ever there was one, and it is not unusual to spend at least an hour in setting a single system. One optical system set in this way was checked in a laboratory and found to be off less than 40 cycles.

The Exciter Lamp Setting

After setting the optical system, the exciter lamp deserves some attention. Here, too, it is impossible to make a setting with the naked eye. For convenience, we usually plug the oscilloscope into the output or monitor jack. The exciter lamp is lighted and focused so as to get a clear field on the photo cell. Then the projector motor is turned on, (no film in the projector) and the gain control brought up until the amplifier output registers as a flat-band oscillogram.

If the oscillogram has jagged edges—*i. e.*, a noise oscillogram—it indicates that the lamp is either too high or too low. Careful adjustment will clear up this noise pattern. When running, the projector motor carries a certain amount of normal vibration to the filament of the exciter lamp[1]. Even though this vibration may be less than .0001 inch, if the exciter lamp is too high or too low, the slit beam will be modulated thereby and effect the output of the amplifier. This is particularly noticeable in high fidelity installations.

(Ed's. Note: A system for vibration measurements, utilizing a special oscilloscope, has been developed by the manufacturer of the "Neobeam". A special folder thereon is available.)

(TO BE CONTINUED)

RCA's 300% Business Rise

RCA Photophone has announced an increase of almost 300% in High Fidelity theatre reproducer installations during the first six months of this year, as compared with last. All new jobs were complete sound systems, it was said, and did not include modernization jobs.

BITTER TWO-MEN SHIFT BATTLE WAGED BY CANADIAN UNIT

By *E. J. WILLIAMS*

SECRETARY, LOCAL 348, VANCOUVER, B. C., CANADA

Projectionists and exhibitors in British Columbia (Can.) have locked horns in a bitter fight revolving around the two-men projection shift standard that has been maintained on the statute books by I. A. units for many years. Tremendous political pressure was exerted by the exhibitors to force a showdown, which took the form of a series of hearings before governmental representatives upon whose decision hinges the fate of the statute.

Details of this titanic struggle are appended hereto for the enlightenment of other units of the craft, not only on the score of procedure and an expose of exhibitor objection to such statutes but also because of the interesting technical data presented.—Ed.

The scope of the current investigation into projection room manpower requisites within the province of British Columbia, presided over by Commissioner J. M. Coady, is indicated by the appended summary of matters to be considered:

(1) Whether it is contrary to public interest to allow less than two licensed projectionists to operate a kinematograph in a projection room containing more than one kinematograph, where an approved automatic fire extinguisher is installed on each kinematograph;

(2) whether it is in the public interest to have more than one class of projectionist in addition to apprentice projectionists; and

(3) to allow a kinematograph to be operated in a moving picture theatre that has no rewind-room; and

(4) to hold examinations for projectionists' licenses elsewhere than in the examining room at Vancouver and by less than a full board of examiners; and

(5) to reduce the period for which temporary permits may be granted from one year to sixty days, and whether the permit shall be restricted to the moving picture theatre in which the permitee is working at the time the permit is granted.

(6) Into all matters incidental to the matters aforesaid.

All B. C. Projectionists Hit

Senator J. W. de B. Farris, K.C., appeared for the theatre interests, and the Hon. Gordon Wismer, K. C., M. L. A., for Local 348, Vancouver, and Local 168, Victoria.

All theatres and projectionists in British Columbia come under the control of the fire marshal and not under individual city ordinances, as is common in most of the United States. Therefore every projectionist in B. C. is affected by the findings of the commission.

Prior to the hearings Commissioner Coady, Brother Pollock, pres. of Local 348 and F. Gow of Famous Players Canadian Corp. visited eight representative theatres so that the Commissioner might acquaint himself with the various types of projection equipment and with procedure.

We opened the proceedings and the following witnesses testified: J. Thomas, fire marshal for B. C.; W. Oswald, assistant fire marshal and theatre inspector; assistant fire chief De Graves of Vancouver; W. Meyer, theatre inspector of Seattle; Mr. Taylor, chief inspector of electrical energy for B. C., who is also a member of the examining board for projectionists; Brother J. Moore, b.a. for Local 159, Portland, Oregon.

The examination and cross examination of these witnesses was very thorough but they all maintained that two qualified projectionists on duty at all times was the best prevention in their opinion of film fires.

We then called Dr. W. F. Seyer of the University of British Columbia who testified on the fire hazards, fumes and gases of nitro-cellulose film. He also expressed the opinion that if the public realized how inflammable nitro-cellulose film is there would be no dispute about safety devices in projection rooms. He also said that anything which tends to reduce the fire hazard and the danger from lethal gases would be desirable. Dr. Seyer testified to some temperature tests he had made in three theatres in Vancouver, the results of which are extremely interesting:

Aperture Temperature Tests

Test A: Peerless L. I. lamp, using National carbons and 50 amps., old-style Simplex with front shutter. Temperature at the aperture, 1040 degrees F. A. flash test with film was made and the film ignited in less than half a second. It was too fast to be timed with a stop watch.

Test B: Brenkert "H" Suprex lamp, Model "H" Motiograph, 62 amps. Temperature at the aperture with shutter open, 1256 degrees F.; with projector running, *i.e.*, with the rear shutter in operation, the temperature was 770 degrees F.

Test C: Ashcraft high-intensity lamp, 100 amps., at the arc, Super-Simplex projector. Temperature at the aperture,

(*Continued on page* 26)

TYPICAL TROUBLES IN MODERN SOUND REPRODUCING UNITS

By *LEROY CHADBOURNE*

STAFF WRITER FOR INTERNATIONAL PROJECTIONIST

II.

FLASH! and a burnt-out amplifier rewarded an experienced projectionist who applied to his new sound system exactly the same inspection procedure followed with the old. An established item of his check-up routine was to lift one of the push-pull output tubes from its socket, in order to read the plate current through the other. His old tubes were tested that way repeatedly; a service engineer had recommended the trick years before. But the first time he tried it with the new amplifier, the thing blew up in his face.

After repairs were completed, he found he would have to test output tubes, thereafter, either by turning off the amplifier and substituting a comparison tube of known plate current, or by using a socket analyzer. He happened to have one of the new systems that would not stand up under this old type of test.

Some of the new equipments will. The difference is a matter of the safety factor built into the apparatus. Greater compactness and lower price for the same power output must be paid for in some way; one way is to work an amplifier at greater efficiency, which may mean closer to the point of break-down.

When one tube of a push-pull pair is removed from service, even momentarily, the plate voltage at the other tube rises. If that tube were normally working at about maximum capacity, the voltage increase thus created might cause a flashover, either in the tube itself or at the socket. In the case just mentioned the socket insulation broke down (prongs of the newer tubes being much more crowded than those of earlier models). The flash overloaded and burned out the power transformer. The tube itself was not damaged: the short circuit protected it. Repairs were limited to a new transformer and a new socket.

Routine Inspection Changes

Although many modern amplifiers would, as stated, easily withstand methods of testing that are dangerous in the case of others, all modern equipment is built to operate at relatively high efficiency, and it is always safest to avoid any test that may create even a temporary overload anywhere. Modern equipment is also relatively compact in construction, further increasing its sensitivity to voltage increase at any point.

A rather similar case occurred in a projection room with non-ventilated lamphouses. The amplifier broke down three times, at approximately four-month intervals. Each time it was returned to its manufacturer, the trouble was found to be socket flash-over, resulting in a burnt-out power transformer. Finally it was sent to the laboratory, not to the repair department, and examined thoroughly. It was washed out with carbon tetrachloride, which was allowed to stand and evaporate. A sediment of carbon dust remained behind. Unquestionably, this dust had collected at the socket and formed a conducting path between the crowded terminals.

The theatre at first doubted the manufacturer's report, stating that with their *old* equipment dust had been blown out with a bellows once a year, and there was never any trouble. But in the old equipment the high-voltage prongs of the output tubes had been separated from ground by more than an inch. In the modern amplifier the spacing was less than ⅛ inch. The theatre eventually agreed to use their bellows once a month, and have had no trouble since.

These two incidents may serve to illustrate differences in inspection and maintenance procedure between earlier and modern sound apparatus. Two specific cases, of course, do not exhaust the list of such differences, which depend in detail upon the design of the apparatus involved.

A minor but useful example lies in a routine precaution once commonly taken against hum. It was, and frequently still is, standard procedure to inspect regularly the holding bolts of the power transformer and the filter chokes, tightening the nuts if found loose. Any loosening of the grip upon laminations usually resulted in apparatus hum. But some modern transformers and coils are riveted; there is nothing to tighten; and if the rivets should work loose, the remedy would be a new part.

Filter condensers used in the earlier amplifiers were almost immune against natural deterioration. High voltage might puncture them, or overheating might boil out some of the insulating compound, but normally they would last forever, because they consisted of sheets of metal spaced by sheets of paper or mica—nothing to spoil.

Nearly all modern amplifiers, however, use electrolytic condensers, which are chemical devices and subject to deterioration from a number of causes. They pack extremely high capacitance into very small space, weigh, and (by comparison) cost almost nothing—but they go bad. Thus in an amplifier in which transformer bolts have been eliminated, the condensers may need watching instead. They in turn will cause hum if internal deterioration causes a decline in capacitance.

The simplest way to check on such filter condensers is to listen to the residual hum in the rectifier output, using test phones. This requires making temporary contact with the internal wiring of the amplifier, which is best done by means of "test prods". The prods are insulated shafts about 6 or 8 inches long, terminat-

The decibel scale of loudness is based on zero representing a loudness of a sound that is barely audible, and the loudness of any sound is measured in decibels above this threshold of audibility.

Loudness in Decibels	*Physical Intensity*	*Example*
0	1	Barely audible.
10	10	Whisper at 5 feet.
20	100	Quiet room; quiet out-of-doors.
30	1000	Quiet office.
40	10,000	Quiet conversation. Early theatre reproducers.
50	100,000	Noisy office; conversation at 5 ft.
60	1,000,000	Loud conversation; busy city traffic; modern theatre reproducer.
70	10,000,000	Loud radio music; push-pull recording and reproduction.
80	100,000,000	Very loud radio music; subway train.
90	1,000,000,000	Pneumatic drill.
100	10,000,000,000	Airplane motor at 10 feet.

ing in replaceable phonograph needles. The test phone wires connect to the phono needles through the insulated shafts. The diameter of these shafts is approximately ¼"; they can reach anywhere even in the most crowded amplifier. If necessary, the sharp needles can be pushed right through insulation to contact the wire inside; the insulation suffers no material damage.

Periodic checks will familiarize the projectionist with the sound of the normal residual hum. In case of increase of hum in the sound, the same test will disclose whether filter output hum has increased, and hence whether the trouble is caused by defective filtering, due probably to deterioration of electolytic condensers. The condensers themselves can always be disconnected and checked on any analyzer equipped to check capacitance. The nearest radio store has such an analyzer.

However, locating the point of the filter output, in the amplifier wiring, may prove considerably more difficult than making these simple tests, which is one reason why circuit diagrams are much more important now than ever before.

Circuit Data Important

Formerly many tests could be made at the terminals of the external wiring. The rectifier and its filter, for example, often occupied a separate panel, wired to the amplifier proper through conduit, and easily tested at a connection point. Circuits today have not increased greatly in complexity, but more of them are grouped in a single cabinet, and the difficulty of tracing them is correspondingly increased.

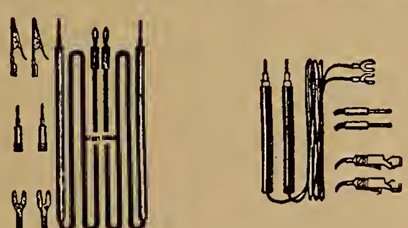
But although these circuits are harder to trace, tracing them is more necessary than ever because there are fewer external connections at which tests can be made, for either trouble-shooting or routine inspection. Sound tests with headphones, and meter tests of voltage or current, are now practically all internal. They are made either with a socket analyzer or with the inexpensive test prods already described, but even where the analyzer is available, the prods often will be needed also, to run down the internal cause of some trouble indicated by the socket readings.

Manufacturers generally have not followed the earlier practice of supplying *wiring* diagrams as well as schematics. This omission occasioned considerable difficulty for projectionists who were competent trouble-shooters. He studied the schematics of new equipment but overlooked identifying the actual parts inside the amplifier case. Formerly he checked the schematic for possible causes of trouble, noting the number of any suspected part, as C-1, R-3, *etc.*, which identified the same part in the *wiring* diagram and which showed its physical position in the amplifier or other assembly. Locating the part in the amplifier itself was made more simple because it bore the same identifying number, painted on.

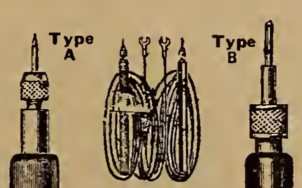
With his new equipment this trouble-shooter studied his schematic as usual; but he didn't have a wiring drawing. He was confronted with a maze of crowded amplifier parts, none of which was numbered. The defective resistor he was looking for was buried out of sight under other equipment, and actually found by unlacing the cable form and tracing wires backward from the sprockets. This loss of time did no harm because there was a duplicate channel; but the trouble-shooter has since studied his amplifier as diligently as his diagram, and has coded many of the actual parts in india ink, in conformity with their diagram numbers.

Another complexity of some recent systems, involving special maintenance problems is the current meter calibrated in percentage instead of in milliamperes. [Two amplifier circuits using meters with this calibration are shown in I. P. for Dec. 1936, pp. 23-4.] The percentage meter has definite advantages when used (through switches) to check on more than one circuit. It is wired through suitable resistors, by means of which it always reads 100% at proper current value. But proper values for two different circuits may be very different in terms of milliamperes. The switching resistors automatically take care of this difference; but in time of trouble the percentage reading is useless for the purpose of applying Ohm's Law to the associated tube circuits.

Accessories for sound reproducer tests



Various test prods



Needle and solderless prods

Pencil-type test leads

Proper conversion tables, prepared in advance and posted, should show what every percentage reading means *in terms of actual current.* Ohm's Law can then be applied to any reading given, as in the case of earlier types of apparatus in which meters were calibrated directly. For ordinary inspection, on the other hand, the percentage reading is sufficient, and the projectionist does not have to remember what is proper current for each of the several circuits under test.

Preparing for Trouble

The double amplifying channel is increasingly important today owing to the impracticability of emergency precautions used in the past. For example, several thousand theatres used an amplifier rack that consisted of three units—voltage, driver and power amplifiers. Because it used the highest operating voltage, and for other reasons, the power stage was the most likely to break down.

A simple precaution was taken. The input and output leads of that amplifier were wired to a switching panel mounted on the same rack. In case of trouble, throwing the switch cut the power amplifier out of circuit; with the speakers being supplied by the driver amplifier, a push-pull stage of the same output impedance. Loss of volume was compensated for as far as possible by raising the fader and the gain control. The power amplifier was then repaired at leisure.

The greater number of modern equipments do not permit this form of emergency precaution: the driver stages are not push-pull; the amplification of the output stage is so great that the output tubes are indispensable (this is especially true where beam power or pentode tubes are used); and, lastly, few modern systems have a separate output unit easily switched in the manner described.

Where the output stage is simply part of a general amplifier, linked to preceding stages by a coupling transformer, or by phase inversion and condenser coupling, switching of this kind would introduce serious circuit complications.

Again, many earlier precautions revolved around the external power supply units, and consisted of either duplicating such units or arrangements by the projectionist to permit easy substitution of storage or B batteries for temporary service. Such precautions are still useful in the case of some speaker field supplies, and d.c. exciter lamp supply, but are impracticable so far as amplification is concerned. Dual channels are the only remedy.

Phone jacks were at one time installed between the different amplifying units to facilitate sound tests at several

points of the circuit. Outage of sound, hums, noises and distortion could be traced readily with that help. The low impedance coupling lines between the component parts of the system (200 or 500 ohms) permitted this use of headphones, the impedance of which is too high to seriously disturb the match. Coupling circuits today are more largely internal, the connection of phones to which presents a more serious problem, and many current amplifiers are so compactly built that space for two or three midget phone jacks is not available. The socket analyzer again suggests itself as the most practicable substitute.

Projectionists with W. E. Mirrophonic systems were upset because another customary precaution was voided. It was routine to test the speakers individually daily. The new equipment has no provision for switching speakers on or off individually, the output circuits not being adaptable at all to simple alteration along those lines. After consulting the manufacturer, it was found that the only remedy was to have an assistant manager walk across the front of the screen each morning and listen to the individual speakers. The management disliked this arrangement, but the projectionist could do nothing about it.

Spare Parts Replacement

The newer apparatus offers several maintenance advantages relative to spare parts. Conspicuously, modern tubes rarely burn out and are not often microphonic. They weaken slowly, but simple plate current readings give ample warning of this deficiency. Consequently, comparatively few spares are carried.

Photo-electric cells also are very reliable; but they now commonly derive their excitation from a common source, a breakdown of which results in high output voltage that may polarize *both* cells. It is smart to carry two cells in stock; they will not deteriorate, as did earlier types.

Exciter lamps, fuses, motor brushes, *etc.*, are not subject to changes of design, and should be serviced as always.

Electrolytic condensers should *not* be bought far in advance, against an indefinite replacement need. They may spoil while standing, especially the cheaper type that are not too thoroughly sealed and tend to dry out.

Power transformers are more likely to break down than formerly. They are also cheaper. An amplifier seldom uses more than one, where formerly three were used in a single unit. A spare may be advisable.

Resistors need special attention in purchase: often amazingly inexpensive, some types can be bought for two or three cents. But even models that cost much more are not rated as accurately as formerly. Some manufacturers allow 10% tolerance; others as much as 25%. Except where wattage requirements are high, resistors guaranteed to be within 1% tolerance can be had for about a dollar apiece, and are preferable. Offer the nearest radio store a small increase in price for a resistor accurately rated, leaving him to choose one from his stock by reading a dozen or two with his ohmmeter. Resistors of the more expensive type, designed to withstand more than 5 watts, are best bought directly from a manufacturer of good reputation, who will advise on request just how accurate are his ratings.

Amplifiers that work their output tubes at voltages close to the rated maximum for the tube in question, and use tubes with many contact prongs crowded close together, are particularly susceptible to socket flash-over, as already explained. In addition to stocking spare output tubes and a spare power transformer, where such amplifiers are used, it is advisable to stock spare output sockets, because the flash-over may occur at the socket itself and ruin it.

If your soldering iron has a somewhat broad tip, as is often the case, a second iron with a very fine tip should be added for getting into the tight places of modern equipment—or the tip alone may be purchased and substituted as occasion requires. If the spare parts cabinet has only solid solder and flux, rosin core solder should be ordered to avoid smearing flux (more or less corrosive) on neighboring parts.

Optics Require Greater Care

Some modern sound optical systems complicate the problem of keeping the optical train clean. An ample supply of lens paper should be available. The relatively simple optical assemblies of the past seldom required the use of lens paper.

The crowding typical of modern construction adds one factor to the specifications for amplifier replacement parts. Formerly the electrical characteristics of such parts constituted the most important factor; today (except when ordered from the original manufacturer) physical dimensions are equally vital. If they are neglected, the replacement may prove too large for the space available. Fortunately, parts of any electrical rating can now be furnished as small as necessary by practically any parts manufacturer or supplier.

To sum up: New designs in equipment may make former inspection routines either dangerous or impracticable, may eliminate causes of possible trouble that formerly needed watching, and introduce others hitherto unknown. Completely new inspection and test routines must be drawn up in accordance with the individual peculiarities of the new system.

Circuit diagrams are more important than formerly, because there are fewer exposed connections that can be used for testing or trouble-shooting, and because crowding makes internal work more difficult. Manufacturers whose products are now popular no longer supply wiring diagrams, and do not number or otherwise identify the component amplifier parts, necessitating study of the equipment itself, as well as the circuit schematic, *in advance*. Special features, such as meters calibrated in percentage, also require advance information, to be posted in a handy spot.

Advance emergency preparations have changed with changes in design; some formerly used are no longer practical and must be replaced or abandoned.

The spare parts problem has also changed considerably; most items are less plentifully stocked, but the opposite is true in some special cases. Parts ratings today sometimes involve unacceptably large tolerances, calling for greater care in purchasing. Crowding has introduced a new specification, that of designating physical dimensions when ordering amplifier components.

Anybody having a copy of I.P. for September, 1936, (Vol. 11, No. 3) for which they have no further use is asked to forward same to the New York Public Library, 42nd St. at 5th Ave., N. Y. City, where it is urgently needed to complete the file to date.

Academy Test Reel, Revised Electrical Characteristics

The Academy of M.P. Arts and Sciences will shortly make available to the industry a sound test reel for use in checking and maintaining the adjustment of the sound projection systems in theatres. This reel will contain a sample section of dialogue and music recording from each of the eight major studios.

A number of prints of the reel are now being prepared for the sound equipment service companies, studios and theatre circuits. Other organizations concerned with the maintenance of sound quality in the theatre may submit requests for prints of the reel to 1217 Taft Bldg., Hollywood. Each request must be approved by the Research Council before prints will be delivered.

The Academy also announced revision in the Standard Electrical Characteristic for two-way reproducing systems in theatres. As a result of tests of new equipment made available to the industry at approximately the time of the issuance of the specifications on March 31, as well as further consideration of existing theatre horn systems equipped with bakelite diaphragms, the Council has revised the standard covering the high-frequency end of the characteristic for these bakelite diaphragm-equipped systems.

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

DELINQUENT employers in the motion picture industry were advised recently by the Internal Revenue Bureau to make immediate tax returns as required under the provisions of Titles VIII and IX of the Social Security Act to avoid further drastic penalties now accruing. Every employee in the industry comes under the provisions of Title VIII, which imposes an income tax on wages. This tax is payable monthly. The present rate for employer and employee alike is 1% of the taxable wages paid and received.

The employer is held responsible for the collection of his employee's tax and is required to collect it when wages are paid. Once the employer makes the 1% deduction from the employee's pay, he becomes the custodian of Federal funds and must account for them to the Bureau.

Penalties for delinquencies are levied against the employer, not the employee, and range from 5 to 25 per cent of the tax due, depending on the period of delinquency. Criminal action may be taken against those who willfully refuse to pay their taxes.

K. C. Rump Unit Out

United Motion Picture Operators and Workers Union for the Film Industry, Inc., of Kansas City (Mo.) was dissolved when Judge Darius A. Brown set aside a decree of incorporation granted June 8. The loss of incorporation by this anti-AFL group occurred when the owner of a neighborhood house called court's attention to a letter in which the UMPOWUFI had used the judge's name in soliciting members to its multi-lettered ranks.

Group is made up of small-house men who broke away from the I. A. about a month ago.

Nat Golden to Head New U. S. Film Department

Creation of a special motion picture division as a unit of the U. S. Dept. of Commerce has gone through, and N. D. Golden has been named chief. Golden is a member of projectionist Local 160, Cleveland, and is known to thousands of I. A. men through his activities in the motion picture field generally and in particular through having served as an officer of the Projection Advisory Council.

The new bureau, heretofore a unit of the Electrical Division, was formed after insistent demands by the motion picture industry for more adequate assistance in the foreign sale of American-made pictures and equipment. About 40% of the total annual income of American producers results from rentals abroad. Golden, recently admitted to the D. C. bar, is also a member of the S.M.P.E. He was wounded in action while with the A.E.F. in France.

Smart St. Louis Boys Grab 63 Sound Service Contracts

Co-operative Sound Service Supply Co., of St. Louis, organized a year ago by Clyde Weston, has signed service contracts with 63 theatres there. St. Louis is one of three large cities where I. A. has imposed a lockout on all servicemen, even those electrics' men who hold I. A. cards, the other cities being Chicago and Cleveland. In all three towns the projectionists have only been replacing tubes for some months now, with all other work going by the board.

Weston was succeeded at Co-operative by T. J. Canavan when the former assumed his present duties as b. a. of St. Louis Local 143.

Technicolor Expands Facilities

As part of its $1,500,000 expansion program, Technicolor will double the capacity of its Hollywood plant. Although its present 100,000,000-foot capacity will be taxed to complete contracts for 1937, Technicolor is offering producers opportunity to produce superfeatures under arrangements similar to those already made with several producers.

CBS Men Go to C. I. O. Despite I. A. Protest

Radio telegraphists and technicians of the eight wholly-owned stations of Columbia Broadcasting System voted C.I.O. affiliation through the Radio Telegraphists' Assoc., over the strenuous opposition of the I. A. T. S. E., an official of which is reported to have stated that such action would result in the CBS men "being out of a job and walking the streets within a month." I. A. only recently announced its intention to go after radio men.

Movies Assist Bad Eyesight, Reports Mental Hygienist

Movies were recommended as a curative for pupils with bad eyesight by Dr. Harry J. Baker, director of the psychological clinic in Detroit public schools, according to an Associated Press report of his address before the N. Y. State Conference on mental hygiene.

"Certain children who have reading difficulty possess a rather large blind spot," said Dr. Baker. "A simple treatment discovered is to put a certain glass to the eye and send the children off to the movies. By the constant eye motion they tend to cultivate the blind spot."

Old-time stereopticon slides, he added, employed a few minutes a day can be used to correct eyes out of focus.

W. C. Labor Front Calm; I. A. Claims Draftsmen; Lessing Out

The West Coast studio labor front is now comparatively calm, the only trouble being the I. A. claim to jurisdiction over studio draftsmen. The trouble stemming from the strike instituted by the Painters Brotherhood was settled when the scenic artists issued a statement apologizing to I. A. for attacks made upon it by the now defunct F.M.P.C. and announcing the withdrawal of Charles Lessing, former F.M.P.C. head, as sole nominee for president of the scenic artists local.

The I. A. had demanded both an apology and Lessing's removal. The latter's nomination and apparently assured election were held by I. A. to violate a verbal agreement reached upon conclusion of the ill-fated strike.

Lessing evidently has left the Hollywood scene permanently. The S.A. statement said that he had returned to his New York home. New nominations were made from the open floor of the S.A. Local meeting.

Dog Tracks Hurt Film Biz.

Film theatre business in Springfield, Mass., is estimated to have fallen off from 40 to 60 per cent since opening of local dog track season, theatre managers estimate. Dog tracks specialize in "free passes," evidently on assumption that betting on canines will net a profit. (P. S.: It does.)

Women To Boycott Fleischer

League of Women Shoppers has notified theatres throughout the country that its members will boycott showings of Fleischer cartoons until settlement of the strike with the Commercial Artists and Designers Union. Union turned down settlement proposal made by Fleischer.

S.M.P.E. to Meet in N. Y.

Next convention of the S.M.P.E. will be held in New York City at the Hotel Pennsylvania, beginning Oct 10. Nominations for new officers have been made but not announced yet.

Fancy Loew Profits; Warner Increases Net By 100%

Loew's, Inc., reported a net profit of $11,714,722 for the 40 weeks' period ended June 3, last, as compared with $7,390,495 for the same period in 1936,

thus showing a gain of $4,324,227. This amounts to $85.68 per share on preferred stock and $7.07 on common.

Warner Bros. Pictures, Inc., and subsidiaries, had a jump of more than 100 per cent in net operating profit for the 39 weeks ending May 29, the total going to $5,561,032.16 after deducting all charges cxcept Federal surtaxes on undistributed profits.

For the same 39 weeks of 1936 the net was $2,554,772.45. The increase was $3,006,259.71.

Where do Profits Go?

The net is equivalent to $53.93 on 103-107 shares of outstanding preferred. Dividends in arrears on this stock June 1 totaled $20.21 per share. After allowances for current dividend requirements on the preferred stock the total was equivalent to $1.42 per share on 3,701,090 shares of common outstanding after deducting shares held in the treasury.

New Dealer Association

The Theatre Equipment Distributors of America, Inc., successor to the defunct Independent Theatre Supply Dealers, at their recent Chicago convention, elected the following officers: Arthur Marrone, president; Joseph Pear, vice-president; E. L. Hurley, secretary; R. Perse, treasurer. The directorate includes: Joseph Guerico, Paul Hueter, Henry Dusman and Marrone.

BITTER TWO-MEN BATTLE IS WAGED BY B. C. UNIT

(*Continued from page* 21)

1265 degrees F., with the projector running or with rear shutter in operation the temperature at the aperture was 752 degrees F.

These tests were all made with a contact-potential thermometer but with the lenses removed and the projector doors open. Dr. Seyer testified that under actual operating conditions—*i.e.*, with the lens in place and the door closed—the temperature would probably have been 100° higher. Film flash tests were also made with equipments mentioned in Sections B. and C. foregoing, and it was impossible to detect any difference in the time it took to ignite the film whether the rear shutters were working or not. In view of the fact that film ignites at between 300 and 320 degrees F., even with the rear shutter there was still more than double the heat required to ignite it. All these tests could not be timed with a stop watch, but they were less than half a second.

(Ed's Note: In I. P. for Oct., 1936, p. 24, appeared a report of similar tests by Dr. A. C. Hardy of the Massachusetts Institute of Technology. Using a copper-constantin thermocouple fastened securely to the aperture plate, Dr. Hardy reported a temperature range of from 84.4 degrees F. at 10 seconds running time to a maximum of 210 degrees F. after 22½ minutes run. Undoubtedly different methods of testing give different results, but hardly explain the very significant difference between the British Columbia tests here reported and those of Dr. Hardy.)

The theatre interests then produced a Mr. Warren from Port Alberni, who is an owner-projectionist with a second-class license. He employs one of our members who works with him. He made a lot of rather ridiculous statements such as that a man could learn to revise and rewind in a few minutes, and that it would be safe to leave an apprentice running the projectors while he was away from the

projection room. He also claimed he could train any man of the "garage type" to run and operate a projector within a period ranging from a few minutes to hours, days or a couple of weeks. Under cross-examination he could not substantiate many of his statements, his "opinion" being that of a very inexperienced projectionist, only having worked in one theatre on one type of equipment. He admitted that he got his second-class license on an examination conducted on the equipment in the theatre which he owns.

Bro. Richards was then questioned further and brought out many points of vital interest to the commission. Many exhibits consisting of records of fires and reports and opinions of experts were introduced and accepted by the commissioner. Bro. Richards stood up very well under examination. He brought out the comparison between the number of fires in British Columbia with one man in the silent days and the number with two men running sound.

Bro. J. O. Thomas followed with the description of a fire he had at a theatre in 1928 when 13,000 feet of film were burned. He described how the fire started and how it spread to the film in the other projector, the rewind bench and to the film stored in the film cabinets. Under cross-examination he explained that had another projectionist been with him, the fire would probably not have occurred, or at least it could have been extinguished at the start. He was at the rewind bench when the film caught fire.

Bro. E. J. Williams, secretary Local 348, was the next witness. He gave a detailed description of projection procedure and the various duties of projectionists, stressing the necessity of having two qualified men in projection rooms at all times both for the protection of the public and to present a smooth and efficient performance. He concluded with information on emergencies, break-downs, revision of film and other matters pertaining to the inquiry.

Union a 'Closed Corporation'

The exhibitors' counsel, Mr. Farris did his utmost to break down numerous statements the witness made, especially the claim that two-men shifts were necessary. Other things he attacked were second-class licenses, revision of film and the estimate of the time it took for the various duties incident to projecting pictures. He also tried to discredit Local 348 on the grounds that we did not accept as apprentices seven or eight men employed by Famous Players. Bro. Williams explained the conditions peculiar to show-business, that there were just so many jobs and vacancies cannot be made unless someone dies, quits the business or a new theatre is built.

Bro. M. Thoreau gave a very clear description of how sound is now an integral part of projection, and the necessity of projectionists having a good working knowledge of the various makes of sound reproducing equipment. He explained how sound is produced right from the sound track on the film to when it comes out of the speakers back stage, covering the sound optical systems, the various stages of amplification, and functions of the principal parts of an amplifier. He came out very well, under cross-examination. This concluded the presentation of our case to the commissioner, who asked every witness many questions on the evidence they had given as well as getting

their opinions on the many subjects now being inquired into.

The exhibitors then put on the stand a Mr. Kershaw, an exhibitor in Winnipeg for many years. He claimed that they only used one man in Manitoba, since discs were dispensed with, and there was very little danger in film fires, and that they very seldom happened. Under cross-examination he was badly discredited in all his important claims, and as he could not substantiate them he was credited with only an "opinion".

(NOTE: The foregoing is an account of only the first sessions of the hearing, which had not been concluded when this issue of I. P. went to press. The outcome and its effect upon present manpower regulations will be reported herein as soon as received.—ED.

COLOR AND SOUND GAINS FEATURE YEAR'S PROGRESS

(*Continued from page* 12)

leaving the strictly amateur classification to enter the semi-professional field; not as a competitor to 35-mm. film, but rather to augment it by filling the need of the smaller communities for film education and entertainment where the expense of 35-mm. equipment is prohibitive. Realizing this, one of the large film producers has, for the first time, announced the release of certain 35-mm. feature pictures on both 35- and 16-mm. film.

SOUND RECORDING

General.—Progress in both recording and reproducing sound was very substantial during the year 1936. The use of class *A* push-pull recording mentioned in last year's report began to expand considerably during the past year. Universal studio made a complete installation of push-pull recording and reproducing channels; while experimental channels were put into operation at Columbia, General Service, and United Artists studios. Squeeze-track recording pioneered by the M-G-M studios, was used very effectively during the past year as a means of extending the volume range in such outstanding productions as *The Great Ziegfeld*, and more recently in *Maytime*. Columbia also did some experimental work in this field during the past year.

In reproducing, two-way horn systems, following the lead of the Fletcher two-way horn development, came into widespread use during 1936. Both Erpi and RCA have offered these systems to the trade; while the Shearer horn system has had wide popularity.[7] The basic element of all these systems is the multicellular horn.

In order further to improve sound reproduction in the theatre, a Committee of the Academy of M. P. Arts & Sciences has been actively investigating the optimal theatre characteristic for sound systems. A report has been issued by the Committee and it is thought that general adherence to the recommended characteristic may prove generally beneficial to the industry.

Little notice has come to the Committee of new picture head projectors in this country, although several new or improved sound attachments were introduced during the year.

Sound Equipment.—Erpi has brought out the Western Electric high-quality heavy-duty reproducer set coded *TA*-7400, forming part of the Mirrophonic sound system. It has a sealed precision kinetic scanner to insure uniform speed of film propulsion and utilizes the latest type of projection optical scanning capable of accommodating single, push-pull, or double sound-track. In addition to these immediately applicable facilities,

[7] Report of the Progress Committee, *J. Soc. Mot. Pict. Eng.*, XXVII (July, 1936), No. 1, p. 45.

it has been designed with the thought in mind of its adaptability to probable future developments in sound recording.

In the W. E. diphonic speaker system Erpi has made available a speaker combination that assures a quality of reproduction more natural and less machine-like than any previously attainable. The cellular construction of the high-frequency horn distributes the sound uniformly to all parts of the theatre. The ample load-carrying capacity provides a greatly increased dynamic range with the same natural quality throughout.

RCA has introduced the type 1060 high-fidelity sound attachment which has a number of new features over previous designs. This unit may be used to reproduce either push-pull or standard recordings. A unique and compact design of push-pull optics is employed, containing a prism assembly for bisecting the light-beam, so designed that all parts are readily accessible for cleaning and observation. A three-point rubber-suspended center-plate includes all the sound reproducing parts (i. e., rotary stabilizer and sound drum, pressure and lateral guide rollers, all optical parts, phototube and phototube transformer), which effectively isolates these critical parts from vibration.

On the main casting are mounted all gears, driving sprockets, and the motor drive assembly. The motor is itself rubber mounted, and employs a universal coupling to the sound reproducer head. Another new feature is the inclusion of a flywheel on the motor shaft, which further insures uniformity of speed and allows the standard three-second starting time without reducing the starting torque, a particularly desirable feature in cold booths. The rotary stabilizer and sound drum shaft use newly designed ball-bearings with a grease seal to eliminate difficult oiling and keep out dirt.

Further improvements have been made in the high-fidelity, two-way loud speaker system employed by RCA to provide high efficiency, low distortion, and improved directional and distribution characteristics. Multicellular horns have been developed to provide a progressive series of sound-distribution angles to accommodate any type of theatre.

The type *PG*-105 theatre sound reproducing equipment has been marketed by RCA for theatres up to 500 seats. This equipment employs the high-fidelity, rotary stabilizer sound attachment, and a two-way high-frequency and low-frequency loud speaker system. Particularly interesting is the new amplifier designed with special consideration for accessibility and high-fidelity performance. The inclusion of the monitor loud speaker in the amplifier cabinet simplifies construction and increases accessibility.

Projectors and Accessories.—International Projector Corp. has announced the new Super Simplex pedestal. This pedestal appears to meet all the requirements of modern projection and sound reproducing equipment, permitting a steadiness

heretofore unequalled. The same company also introduced a slip-in gate for the Super Simplex projector that can be easily and quickly removed by unscrewing two thumb-screws. This permits the projectionist to clean it carefully at will. It also assures positive location of the guiding elements and is recognized as a device that meets a requirement of long standing.

During the latter part of the year an intermittent sprocket that was hardened and accurately ground was introduced for use with the Simplex projector mechanism. The accuracy of the sprocket materially assists in projecting a satisfactory picture, and the hardening process lengthens its life considerably. This sprocket is now being furnished on all new and repaired Super-Simplex mechanisms and is unquestionably of the highest quality and accuracy.

Erpi has introduced a new type of double-film attachment designed as an adjunct to the new W. E. heavy-duty reproducer. It provides a means of reproducing separate sound and picture records on 1000-ft. reels, and permits the use of 2000-ft. reels when single film is run. The film in the double-film attachment is guided by means of idler rollers, or a driven sprocket as an alternate arrangement, and the film path is such that the sound-film enters the sound-head in essentially the same manner as it does for normal threading.

There is no difference in the quality of sound obtained from film operating from the double-film attachment compared with that of film threaded in the standard manner. Strippers and idler rollers have been so located that film "jams" are virtually impossible.

In motion picture projectors built by Friedl and Chaloupka, Vienna, the framing is of special interest and is accomplished by turning the Maltese cross about its axis. This form of construction is unique and rather difficult, since the moving period must be kept in constant step with the position of the revolving shutter. The shutter is controlled directly by the driving mechanism, not depending upon the Maltese cross, while the Maltese cross is adjusted by means of a differential gear to keep the moving period constant.

The shutter, of the metal-barrel type, is arranged between light-source and film. The safety shutter consists of a centrifugal shutter within a barrel shutter. The double-hinged gate is of interest. The gate hinge is close to the film-track in most projectors, so that loading the film and cleaning the film-track are difficult. The film is completely exposed upon opening the double-hinged gate, and the difficulties mentioned are entirely eliminated.

The motor is mounted laterally and parallel to the base. An intermittent mechanism between motor and projector permits frequencies of 24, 25½, and 27 frames per second. The cylindrical lamp housing is lined with highly polished aluminum to prevent heat radiation.

Ip

International PROJECTIONIST

AUGUST 1937 Vol. 12, No. 8

25c Copy $2 a year

For Photo Cell Spares and Replacements

specify

VISITRON

PHOTO CELLS

Look for the G-M monogram

For your protection ask your supply dealer to deliver Visitron Photoelectric Cells.

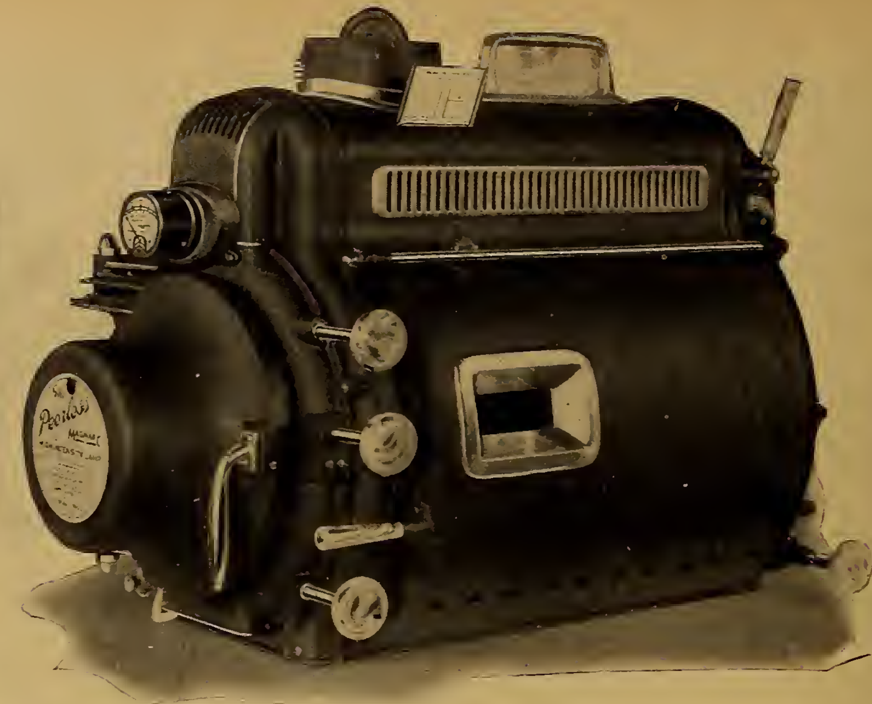
Visitron Photoelectric Cells are guaranteed to deliver maximum service value. They are products of G-M Laboratories, Inc., the organization that promoted the photoelectric cell for motion picture and industrial use.

Visitrons are standard priced; you get full value, guaranteed performance without one cent added expense. Forget your photo cell worries. Ask for G-M Visitrons!

G-M LABORATORIES INC.

1735 Belmont Ave., CHICAGO, ILL.

ORDER VISITRON CELLS FROM YOUR EQUIPMENT DEALER



International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 12 AUGUST 1937 *Number 8*

Published Monthly by

JAMES J. FINN PUBLISHING CORPORATION

580 FIFTH AVENUE, NEW YORK, N. Y.

Circulation Manager, RUTH ENTRACHT

SUBSCRIPTION REPRESENTATIVES

AUSTRALIA: McGills, 183 Elizabeth St., Melbourne
NEW ZEALAND: Te Aro Book Depot, Ltd., 64 Courtenay Place Wellington
ENGLAND AND DOMINIONS: Wm. Dawson & Sons, Ltd., Pilgrim St., London, E. C. 4.

YEARLY SUBSCRIPTION: United States and possessions, $2 (two years, $3); Canada and foreign countries, $2.50. Single copies, 25 cents. Changes of address should be submitted two weeks in advance of publication date to insure receipt of current issue. Entered as second-class matter February 8, 1932, at the Post Office at New York, N. Y. under the act of March 3, 1879.

420

MONTHLY CHAT

UTILIZATION of the sit-down strike by New York projectionists fails to impress exhibitors throughout the country. They assert that this technique is merely an extension and, possibly, a refinement of a practice that has endured for years. Anyhow, this is all the fault of F. H. Richardson: he never could understand why projectionists should be expected to stand all day.

DIVESTMENT of Erpi by its parent body, A. T. & T., as forecast herein many times within the past three years, means that the matter of theatre sound system servicing will be laid right in the laps of local unions—also forecast herein as long ago as 1933. The really alert units are prepared. The others—well . . .

HARRY ARTHUR, head of a St. Louis circuit of theatres, publicly declares that he would never return to the old system of servicing offered by the electrics. He is currently using service rendered by an "independent" company, which is closely tied to St. Louis projectionist union. We know of nothing in the St. Louis climate that restricts this plan to that area.

PRESENT indications are that more than 10 per cent of the total Hollywood production during 1938 will be in color. Neither Eastman nor Technicolor will oppose this trend, of course; but the crimes being committed in the name of projection when this product is shown by means of rat-trap equipment in more than 50 per cent of America's theatres will testify anew to the almost unbelievable stupidity of those directing the world's fifth largest industry.

PUT this question to your partner: How long is a single frame of film at rest before the aperture, assuming a standard rate of speed of 90 ft. per minute? The answer appears elsewhere herein; but the vital point is how one arrives at this answer. Try it.

INCIDENTALLY, we still marvel at the sales resistance of small theatres to the Suprex Arc, which was originally intended to supplant the low-intensity arc. Inevitably, National Carbon Co. will soon announce a larger Suprex carbon, the benefits of which will again be reaped by the larger houses. The combination of pastel colors (now in vogue) and a low-intensity arc will produce results too horrible to contemplate.

HOW about an overhaul of the projector head, and such other equipment as may need inspection, before the new season opens?

CONTRIBUTIONS to these columns by practical projectionists are steadily on the increase. But there is more gold in them thar hills. How about it?

INTERNATIONAL PROJECTIONIST

VOLUME XII NUMBER 8

AUGUST 1937

HOT FUSES: TROUBLES INCIDENT THERETO, AND THE REMEDIES

By *A. C. SCHROEDER*

MEMBER, PROJECTIONIST LOCAL UNION 150, LOS ANGELES, CALIFORNIA

THE flow of an electric current through a conductor produces heat, the amount depending upon the strength of the current and the resistance through which it flows. The resistance of most substances increases with a rise in temperature, thus producing still more heat, which again raises the resistance. This continues until either a state of balance is reached or the conductor "burns up." Fuses and their connecting apparatus behave similarly.

Hot fuses are a general condition, at least in Los Angeles. Some projectionists think nothing at all about the condition; others worry themselves sick over it, proclaiming that something should be done to make the management rectify the trouble.

If the circuits are overloaded, it is a lead-pipe cinch that the management, or whoever is responsible for the condition, should correct it. But in nearly every case found by the writer the heating was due not to overload but to improper contacts between the parts of the fuse and the parts on the fuse block. This is caused by the reduction of the contact area: current that should flow through a contact having an area of 1 square inch must now flow through a contact having an area of only ¼ square inch, producing four times the heat that it would if conditions were correct. No wonder it smells like burning horse meat when you touch it with a finger!

Causes of Fuse Failure

Many think that this condition can only arise from mishandling and abuse; but this is not so. Much of the new equipment is already in such shape that anywhere near maximum area of contact is impossible—that is, without corrective measures by the projectionist. The needed corrections do not require any great amount of skill but only some *careful* work.

If a fuse must be changed every few weeks, it is probably due to heat, usually caused by a poor contact somewhere. It is quite possible, of course, that the fuse is being worked above its capacity, or there may be a defect in the circuit or apparatus which puts a momentary surge of current through it and thus causes failure. When the fibre portion of a fuse is charred, or even if it is only discolored and has not yet become black, the condition is due to heat. Any parts that are unbearably hot to the touch are too hot; something will happen sooner or later, and should be remedied. A fuse, or any adjacent part, that is only slightly warm is operating under practically normal conditions. It is hardly possible to produce a condition where the fuses will be absolutely cold if they are carrying the maximum allowable current. Only a trace of warmth is a fine condition; comfortably warm is not bad; very warm to unbearably hot should certainly be looked into, as something is radically wrong.

FIGURE 1

Figure 1 shows a fuse with a straight-edge placed on the end contact to show that this part has been bent, and it will therefore be impossible to get 100%

contact here. Notice the white line between the scale and that part of the fuse it is resting on. The scale only touches the fuse at the two points shown by the upper arrows. The three arrows

FIGURE 2

show the only points that will touch the clip into which the fuse is placed. This gives three line contacts between one end of the fuse and its connection to the external circuit. The normal and intended contact area at this end of the fuse is about 1½ square inches.

What would you think the contact area would be under the conditions depicted in Fig. 1? My guess is about ⅛ square inch, and certainly not more than ¼ square inch.

This is an actual picture of a fuse obtained from a supply house. True, it is worse than the average; in fact, it is the worst one I could find after considerable hunting. I fear that the small gap I see in the print before me may be lost when reproduced in halftone herein.

If a straight-edge were put underneath, it would touch the point shown by the lower arrow and there would be a gap at the two ends. The straight-edge could be rocked on this part, showing that it was rounded.

Most fuses have some such defect. Few of them are as bad as this one, but even if it is bent only in the slightest degree, it reduces the contact. The fuse, when inspected as in Fig. 1, may be perfect; but turn the fuse through a 90-degree angle, so that you are looking at the *end* of it, leaving the scale as it is in the picture and resting over the part indicated by the lower arrow (the scale is now crosswise on the fuse) and look for a gap at either the center or the edges. The chances are that you will find it. This shows if the metal is bent in a direction at right angles to the bend shown in Fig. 1.

Forms of Corrective Action

If the bend is very bad, it should first be straightened in a vise, either by pressing it between the jaws or laying it on the flat surface and hitting it with a hammer. In any event, care must be taken not to put any indentations in the metal, either by the vise jaws or by the peening action of the hammer. Place a piece of smooth metal on the jaws of the vise; or, if using the hammer, put a fairly heavy, flat, and smooth piece of metal over it, so the hammer strikes the metal rather than the fuse. Any indentation or irregularity in the surface of the fuse reduces the contact again.

After the straightening process, the surfaces must be filed *flat*. This cannot be done in the way the average man files, which would result in rounded surfaces, probably worse than the condition to be corrected. A machinist or anyone experienced in filing would put the fuse in a vise and file it flat; but the projectionist had better do it as shown in Fig. 2.

One end of the file is placed against some object, such as the corner formed where the vise is fastened to the bench. The other end rests against the stomach, thus forcing the file into the aforementioned corner. The fuse is then placed on the file, the finger of the right hand is placed above the part to be filed and holds it firmly in contact with the file

FIGURE 3

so that the fuse cannot rock and round the corners.

The thumb will hold the fuse better than the finger can. The finger is shown in the illustration because it keeps the hand away further and permits a clearer shot. The left hand is supplying most of the "push-pull," which is done so that no twisting or rocking motion is imparted to the fuse. As shown, the cutting stroke is made when the motion is toward the operator; in case the file is turned around, the cutting is done when moving away from the operator, which will be easier, but a rag must be put between the file and one's tummy.

Only enough metal should be removed to produce a flat surface, which has been obtained when the entire surface is shiny from filing. If too much metal is removed, this part becomes too thin, and the clip into which it fits may have to close so much that it comes up at an angle; the ends of the clip will be closer together than the part near the base, resulting in only the ends of the clip touching the fuse. That is why the fuse should be straightened before filing, so as little metal as possible is removed. If too much is filed off, there is also the possibility of getting the two surfaces out of parallel with each other, thus again reducing the area of contact with the clip.

In Fig. 3 the shell has been removed and the end has been filed, not much, but only enough to show the condition it was in. Notice the shape and position of the light areas made by the file, disclosing that the metal has been bent in two directions. This same fuse is shown in Fig. 1, but it was "doctored" thereafter, being bent at right angles to the first bend, care being taken not to change the bend shown in Fig. 1. This was done to show what it looks like, because such a condition sometimes occurs.

If the fuse in Fig. 1 had not been altered, but the file had been rocked, it would also appear as in Fig. 3. Of course, when the opposite side is filed the pattern will look different. Work slowly and watch the progress being made. When the entire surface has been filed, test it again with the straight-edge, in two directions, to make sure that it is correct.

Ferrule-Type Fuse Clips

Figure 4 shows an old-type switch, with ferrule-type fuse clips, one of which has been removed and is shown in front of the switch. One end of part A rests on and is normally fastened on top of part B. Contact between these surfaces is as important as those between the fuse and the clip. Heat, produced here is conducted to the fuse and will cause trouble. The test and treatment are the same as described above.

If B is only slightly bent in an even bow, that is, no kinks or sharp bends are present, it may be left as is, because it will draw down flat when A is fastened down securely. With this type

FIGURE 4

fuse it is not practical to improve the contact between the fuse and the clip.

The upper surfaces of the end A, next to the arrow, is where the lug on the

(*Continued on page* 29)

Throw Out Our Repair Kit! . . .

. . . here come Our New MOTIOGRAPHS!

Nuts, bolts, haywire wrenches and pliers . . . projectionists all over the country are tossing all of their repair worries on the scrap pile . . . that is, of course, wherever a pair of Motiographs enter the booth!

Motiographs have always been known for their trouble-free performance . . . especially the Model "K". From Broadway to Manila and back again, these modern projectors are setting a new standard in performance . . . the "utmost in screen results."

Next time you tour "Film Row" see the floor model displayed at the Motiograph distributor . . . then tell your "chief" he can swing a deal on only $15 to $20 per week. The complete projector, less lamp and sound head, lists at $1235.00 F.O.B. Chicago.

THE NEON TUBE OSCILLOSCOPE AS A PRECISION SERVICING INSTRUMENT

By *THEODORE P. HOVER*

MEMBER, PROJECTIONIST LOCAL UNION 349, LIMA, OHIO

This is the second and concluding article of the series detailing the applicability of the oscilloscope to projection room servicing work. Amplifier checking was described last month; this instalment covers checking of the optical system, measurement of mechanical vibration and use of the oscilloscope as a stroboscope.—*Editor.*

II.

ANOTHER source of noise, distortion and modulation of the reproduced sound may be found in loose elements in the optical system. A rubber hammer, made by placing a 1-inch square eraser on the end of a pencil, will help locate these faults. A sound band should be threaded through the mechanism, the gain control opened to normal and the oscilloscope connected the same way as for exciter lamp settings. Tap the lens barrel very lightly. A jagged oscillogram is a sure indication of either a loose lens unit or a loose slit, both troubles being much more common than is suspected.

Frequent examination should be made of the brackets which support the exciter lamps, as they have a tendency to work loose, and the slightest vibration is sure to modulate or distort the sound. The same can be said for the brackets which hold the optical system and aperture plate in place.

Frequent examination should also be given to set screws which hold prisms and p.e.c. mirrors, where this type of equipment is used. It is the height of foolishness to install quality optical systems guaranteed to split a beam .0008 inches and then permit loose brackets and screws to vibrate as much as .005 inches. Yet, this condition is often responsible for poor reproduction from otherwise excellent equipment.

One typical instance proves this point: The manager of a theatre complained that the sound was a trifle mushy and lacked brilliance, and, in particular, the female voice sounded dead. The projectionist held that it could not be the optical systems, inasmuch as new optical systems had been installed six months previously; also, new tension springs and pads. A check-up showed that the wrong type of tension springs had been installed, resulting in abnormal pressure on the film in the sound aperture. With less than six month's use, the aperture plate was worn more than 1/32 inch, enough to cut out the entire top register of the sound. New aperture plates and refocusing ended the trouble.

Noise Problems Overcome Easily

With this same set-up, loose connections, defective wiring and also defective lead cable can be easily located by carefully watching the oscillogram as wiring and terminals are moved or shaken. It is our belief that many of the noise problems which arise in high-gain p.e.c. circuits are caused by defective and broken down insulation in lead-covered wires. Microphonic tubes also show up if they are touched or vibrated slightly. When a very shallow noise oscillogram appears, and tubes and other equipment are apparently in good condition, one may expect a noisy photo-cell, which may be checked by short-circuiting or, in some cases, removing the cell, which should stop the noise.

It should be remembered that the oscilloscope has a self-contained high-gain amplifier, and earphones may be connected to the output of this amplifier when the projectionist wishes to hear as well as see the fault.

The oscilloscope lends itself readily to the addition of many types of auxiliary equipment. For the analysis and comparison of mechanical vibration the oscilloscope cannot be surpassed. For this work, a vibration pickup of some type is necessary (see Fig. 5).

FIGURE 5
Checking vibration on gears

Any type of magnetic or crystal pickup can be fitted with a needle or test prod and hooked up to the input of the oscilloscope. Very accurate measurements can be made, using the inertia-type crystal microphone built especially for sound pickup from vibrating bodies by the manufacturers of the oscilloscope. Every type of sound equipment on the market today has a mechanical link between the projector mechanism and motor, or sound mechanism and motor. This link may be either a micarta and steel gear train, a sprocket and chain, or a belt drive.

Where gear trains are used, and the setting of these gears is variable, it is of the greatest importance that these gears be properly spaced and aligned, otherwise the gears rapidly wear out, or the sound quality suffers. Gears that are set too close tend to knock out the teeth; while those that are set too loose permit backlash.

The vibration pickup should be connected to the oscilloscope and the test prod placed on the center of the shaft or bearing nearest to the gear. The oscillogram developed by perfectly meshed gears closely resembles the teeth of the gear itself. When gears are set too tightly or out of line, another oscillogram is set up, which follows closely that of the normal noise-of-operation oscillogram. If too far out of line or too tight, this parasitic oscillogram may even overshadow the normal one. If too loose, the backlash can be easily seen and identified by its irregular character.

Adjusting Gears, Belts, Chains

We have found that gears, belts and chains can be satisfactorily adjusted by having one projectionist change the adjustment, while the other holds the contact pickup in place. By taking a continuous reading during this operation, it is easy to select the point of least vibration and smoothest operation. It has been our experience, however, with helical and spiral cut gears, that attempts are often made to tighten up the setting of these gears after they have become considerably worn. This is seldom successful, and if the gears are set up too much, they will almost immediately be damaged beyond repair.

The only answer to a badly worn gear train is not to set them tighter, but to install an *entire new assembly!*

In a majority of sound equipments, gear and chain noise can be carried directly through to the sound sprockets, where it will be communicated to the film and thereby modulate the sound causing a distinct flutter, particularly noticeable by the "sour" sound of sustained violin and organ notes.

The magnetic pickup will find innumerable uses in the projection room, where a little adjustment and close checking of the type of lubrication used will effect wonders in reducing gear noise, vibration, and wear on parts.

Often the operation of a motor generator tends to cause harmonic vibrations in girders and beams supporting the projection room. The contact pickup should be placed at the point of greatest vibration, and the generator can then be balanced or silenced with cork pads or small wedges. Even the slightest change is immediately shown by the oscilloscope.

Use as a Stroboscope

Another gadget developed by our members for use with the oscilloscope is a stroboscope attachment. This is simply a single-contact automobile lamp socket attached to an extension cord with clips which permit it to be connected to the exciter lamp supply. The socket is fitted with an automobile lamp of the same voltage as the lamp supply, or an old exciter lamp will work. A bracket is soldered to the socket.

We pulled the mechanism of the oscilloscope out of its case and cut away a small piece of the metal shield surrounding the rotating mirror. This cut is made on the side opposite the neon tube. The bracket holding the socket and lamp is then bent so that the light from the lamp will be picked up by the rotating mirror and projected through the opening in the front of the oscilloscope. The bracket may be made of a thin strip of brass or sheet metal with a hook in the end which will permit it to be hung on the top of the mirror shield. It can be loosely fitted so that when not in use it can be lifted off and removed through the back of the oscilloscope. Care should be used so that it does not interfere with and cannot fall into the rotating mirror, where it would do considerable damage.

We mounted our lamp rigidly and brought the cable out through a graummet in the back of the case; and since it is located off to one side, it does not interfere with the operation of the oscilloscope. A cardboard mask with a 1-inch hole in the center was cut to fit the hole in the front of the oscilloscope, and is held in place by two small pieces of adhesive tape. The oscilloscope is then turned on and the stroboscope lamp is lighted, preferably from a d.c. source. The rotating mirror will pick up the light from this lamp and, by reflection, throw out a beam of light through the 1-inch hole in the mask.

Since the mirror is calibrated up to 1000 r.p.m., and there are two sides to the mirror, an intermittent flashing beam of light with a frequency up to 2000 will be available for analysis of mechanical motion. Since the speed of various moving parts in a projector is usually less than 2000 r.p.m., it will be possible to analyze the motion of every gear and shaft in a projector. This intermittent beam of light operates with the same effect that motion picture cameras used to achieve when taking shots of moving wheels at 60 feet per minute. When the wheels were in synchronism with the shutter of the camera, they apparently stood still on the screen.

An entire paper could be written dealing with the various uses for this development. It is only necessary to darken the room as completely as possible, direct the beam of light upon the moving gear or shaft and then synchronize the motion of the light and shaft with the synchronizing control of the oscilloscope.

The theatre manager who is sure that his projector mechanism overhauling job is "just as good as an expensive job," should look at the gears and shafts under this flashing light, as the results obtained tell their own story.

In concluding this paper we wish to point out that the rugged and foolproof construction of the neon tube oscilloscope make it an ideal instrument for projection room servicing. The amplifier tubes can be purchased in any radio store, and the neon tube itself costs no more than the average radio tube. We cannot give accurate information concerning the life of the tube as ours has run over 4000 hours and so far shows no sign of wear or deterioration.

A number of theatre managers have used our instrument for ballyhoo purposes, by placing it in the foyer of the theatre and connecting it to the sound system. This was particularly effective for advertising a new high-fidelity installation.

A Versatile, Accurate Instrument

It has not been our intention to "sell" the oscilloscope as a cure-all for sound system troubles. In its place it represents one of the most versatile and accurate instruments available to the projection craft. But it must be used carefully, accurately, and intelligently.

The members of our Local long ago adopted the idea of purchasing service and maintenance equipment, with due respect to that already in the hands of other members. Not every member can afford to purchase a complete optical, electrical, and mechanical laboratory. Our policy has been one of cooperation between the members, with the result that each individual member has for his use approximatetly $5.000 worth of laboratory equipment, in addition to that which he himself owns. Where individual members feel that they cannot purchase proper test equipment, the idea of clubbing together to buy equipment and then using it cooperatively may well be adopted by local unions or clubs within the unions. Our membership stands ready at any time to cooperate and assist other locals in their servicing problems.

FRED J. DEMPSEY

FRED J. DEMPSEY, 52, for the past seven years General Secretary-Treasurer of the I.A.T.S.E., succumbed to a complication of diseases at his summer home near Boston, Mass., on Aug. 15. His death, while wholly unexpected, followed a long period during which he had been under a doctor's care. The funeral was held on Aug. 18, in Boston, Mass., and was attended by representatives of practically every New England unit of the I. A., and by the entire staff of the General Office. Ranking officials of the I. A. were unable to attend, having just reached Seattle, Wash., for the bi-annual meeting of the Executive Board. Practically all of Dempsey's adult life was given over to Labor activities. He served as business representative of Boston Stagehands Local 11 for many years, and was 1st vice-president of the I. A. in 1930 when the Los Angeles Convention elected him to the post he held at his death. His present term would have expired in 1940.

F. J. Dempsey

DOUBLE FEATURES OUT IN CHI. WITH NEW SEASON

Double-feature programs are expected to be dropped in all Chicago theatres with beginning of the Fall release season. Independents are reported to have reached an agreement on this with Balaban & Katz circuit, which sets the Chicago operating pace. Double-feature bills is industry's current most controversial topic, with all American theatres, except so-called deluxers, featuring that type of program.

Polls Show Singles Preferred

Private polls, including one each by Warner Bros. and the magazine *Fortune*, have uncovered overwhelming public sentiment for single features; but industry continued practice. A general return to single-feature bills would mean a drastic drop in production activity and consequent decreased studio employment.

TYPICAL TROUBLES IN MODERN SOUND REPRODUCING UNITS

By *LEROY CHADBOURNE*

III.

FOLLOWING are some recent, actual cases of projection room troubles which were mishandled. Improper action, lack of ordinary common sense resulted, in some cases, in unnecessary delay in making repairs. In others, things necessary to prevent a repetition were left undone. In still others, the procedure followed introduced new and different troubles, or occasioned unnecessary expense.

Case 1. A three-man crew, reporting an hour before showtime, got no sound. Each of the three proceeded on his own. One switched off the power and changed *all* tubes. Another cleaned the fader. The third did something else. All this work was at random, employing neither system nor coordination, and none of the three paid any attention to the others. After half an hour of this effort, they tried the system again. They had sound. The show went on.

Offhand, such trouble-shooting, which may fairly be termed "the panic method," may seem justified because it was successful. But is was not successful; it was only lucky. No one now knows whether these frantic efforts really cured a faulty condition, or the trouble disappeared of itself, to return subsequently. If it recurs, no one knows what precaution to take; no one knows what it was or has learned anything from the incident. And there still remain under suspicion one hundred dollars worth of tubes that will have to be tested individually.

In this case, systematic use of switches and headphones would have isolated the trouble in less than half an hour; the repairs made would be permanent and be known to be so; any additional precautions needed could be undertaken intelligently, and there would be no doubtful tubes. Finally, all concerned would have learned something that would undoubtedly prove useful in the future.

Tube Change Not Conclusive

Case 2. A similar procedure was followed in a theatre equipped with regular and emergency amplifiers. The regular amplifier blew its fuse repeatedly. The show continued with the emergency system, and the regular board was "repaired" by changing all tubes. Four doubtful tubes were returned to stock, without any effort being made to ascertain which of the four was faulty. The futility of such procedure will be made clear when Case 4 is considered.

Note, however, that there was no excuse at all for doing things haphazardly, as the existence of dual amplifying channels obviated any need for haste.

Case 3. The handling of this case constituted a double fault in projection room procedure. A comparatively new tube proved defective in that the active material was peeling off the filament. This condition is sometimes characterized by a hissing sound in the speakers, somewhat like the old photo-cell hiss, or like rushing water. The faulty tube happened to be in the first stage of amplification where, of course, its noise would be amplified most strongly.

No replacement tube could be found in the projection room! The only possible remedy, pending receipt of new supplies, was to substitute the noisy tube in another socket where it would not cause quite as much trouble. The show continued with the disturbance still present, but not as loud as formerly. After six hours of noisy sound a new shift came on duty and announced that of course there were spare tubes. They were found at once, at the bottom of a clothes locker under someone's old overalls, still in their original sealed cartons!

The second example of faulty procedure in this case turned up after the replacement had been made. Someone recalled that the faulty tube was comparatively new and suggested that it be returned to its maker for exchange. Then it was found that the tube had never been marked with the date of installation, nor was its serial number noted in the log book on the day it was installed. There being no way to establish the number of hours of use, the theatre was out the price of a tube.

Case 4. We come now to a flagrant, three-sided case of improper practice, embracing about all the mistakes that could reasonably be expected in connection with only one trouble. This difficulty also appeared before showtime. It was a severe crackling noise, practically continuous, and loud enough to make sound almost inaudible. There was no emergency system. The equipment had been modernized recently, but was not of the very latest type—despite modernization, it still used C batteries.

Again the first step, as before, was to change every tube in the equipment. This effected no improvement. Then the C batteries were tested with headphones. One seemed slightly noisy; its defect might possibly, after amplification, account for the trouble. Search was made for new C batteries. There weren't any.

At this point a more systematic method was introduced. It was noted that change in the fader setting did not change the volume of the disturbance; but a change of the amplifier volume control did. Therefore the trouble was—it had to be—between the fader and the amplifier volume control. Every other possibility was automatically eliminated.

Systematic Elimination of Suspects

The next question was: Did the difficulty lie in the amplifier itself, ahead of the volume control? or in the cable between the amplifier and the fader? The amplifier sound input in this case was made to binding posts fitted with thumbscrews. The easiest test was to remove the input wires. When this was done the noise stopped at once, removing suspicion from the amplifier, its tubes and its C batteries, and proving that the trouble must lie between the cable connection just opened and the fader from which it came.

Here luck stepped in. A glance at that part of the cable which connected to the amplifier showed its lead sheath cutting into insulation and touching one of the wires. The condition must have dated back to the time the system was installed; vibration working over a period of time did the rest.

The fault was corrected; the show went on; an O.K. was passed along to the management. Then, about three minutes after the beginning of the second reel, the same noise was heard again and continued until the change-over, when it disappeared. The noisy projector amplifier was at once investigated with headphones, and the new trouble found. One of the replacement tubes installed during the unnecessary procedure of changing every tube in the system proved to be defective; it was quiet while cold, but became noisy after a few minutes of use, expansion of the parts apparently developing an internal loose connection.

In this case, every step of the pro-

cedure was wrong. For one thing, trouble-shooting began with changing all tubes, instead of with the method of isolation that was afterward followed successfully. This was a waste of time: no changes of tubes could either reveal or cure a "ground" in a lead-covered cable. The only result was to disclose the possibility of another trouble adding itself to the one already present.

Second, a defective tube was left in the spare parts cabinet for emergency use. It was probably put there on some previous occasion when trouble was "cured" by changing all tubes, instead of by careful checking—put there untested and unmarked to cause trouble in the future. Third, the stock of spares was incomplete in that no C batteries were available. As it happened, the C battery was not the direct cause of the noisy sound. Suppose it had been?

Group of Basic Faults

The four cases thus far considered illustrate five basic types of faulty projection room procedure:

a. The "panic method" of trouble-shooting which succeeds (if at all) only through luck; but is likely to prove a waste of time, does not reveal the nature of the difficulty, does not make precautions possible or provide anyone with a lesson or example worth remembering.

b. Restoration to stock of doubtful parts, unmarked and untested, which may subsequently create an emergency or complicate trouble-shooting.

c. Storing spare parts in unusual or obscure places where they may be forgotten and certainly cannot be found by relief men.

d. Letting the stock of spares run down so far that parts needed in an emergency are not available.

e. Failing to mark tubes and other parts with the date they are put in use, so credit can be obtained if they fail to stand up. (If stickers or china marking crayon are not available, the serial number of the part can be noted in the log book).

Case 5. In this case the low-voltage speaker fields receive excitation from a full-wave rectifier. The output of the rectifier is 12 volts; the speakers are designed for an input of 7 volts. The difference is taken up by dropping resistors mounted in a metal cage, which permits ventilation but prevents burned fingers.

These resistors have burned out repeatedly, being worked right up to the limit of their rated wattage capacity. Every time one burns out, the speakers supplying one-half the auditorium stop functioning—thus, one-half the seats are left without proper volume, and with

(*Continued on page* 27)

PROJECTOR MECHANISM TOLERANCES AND INTOLERANCES

By *HERBERT GRIFFIN*

VICE-PRESIDENT, INTERNATIONAL PROJECTOR CORPORATION

Over a luncheon table some two months ago the author of the appended article talked engagingly, but fast, about the function of a motion picture projector—its components, tolerances and sundry other interesting aspects of one of the most delicately-balanced mechanisms in the world. Stemming the flow of words momentarily, we exacted a promise to set down these data. Perseverance having been rewarded, we now present data on projectors which, if not entirely new, appear here in new dress. Our thanks to Mr. Griffin for the article—and for the luncheon.—Ed.

PROJECTION of a motion picture depends solely and completely upon the cam pin—a tiny, short, stubby pin of tool steel, accurately hardened and ground to a dimension of 0.100", plus or minus .00005". This pin operates in the four slots of the star wheel (the entire star being completely hardened and accurately ground to plus or minus another half a tenth), and the slots are lapped to closely fit the pin.

The radius of the cam, also hardened and accurately ground to plus or minus half a tenth, must fit the star radius exactly in order that absolute steadiness of the projected picture may be obtained. Any variation in these dimensions naturally causes the picture to "jump" on the screen.

The little pin above referred to does the work of pulling each single picture past the aperture plate, but each slot of the star does only 25% of this work. In this connection, I might point out that it is not at all unusual for us to receive Super-Simplex mechanisms sent in for repairs after a year and a half to two years use with the pin worn much more than .0005" below its original manufactured dimension, and the slots in the star are almost as good as new. It is rare that any major repairs are necessary on the intermittent movement of the Super-Simplex mechanism.

Close Tolerances Required

The sprocket on the intermittent shaft has to do the work of pulling each successive picture into place; and when it is projected as a still picture through the lens to the screen (the original picture being only .600 x .825" at the aperture and sometimes projected to a width of 50 feet) it is quite evident that the magnification ranges as high as 700 to 800 times. From this one can realize what close manufacturing tolerances are required in order to maintain a picture of such magnitude steady both laterally and vertically on the screen.

Anybody can figure the number of tons the cam pin, star slots and sprocket teeth handle, when it is considered that an eight-ounce tension is always applied at the gate and the picture must be moved from rest to the next picture in 1/96th of a second. This continues day in and day out, month in and month out, all year long. Both the exhibitor and projectionist have come to regard this phenomenon, if they think of it at all, without any thought of failure, because the mechanism has been performing this function every day for years.

Here are some interesting figures on picture displacement at the aperture: Taking the average day's run as eleven hours and splitting it between two projectors, each mechanism must handle during its five and one half hours of operation a day, 1,440 pictures per minute, 86,400 per hour, 475,200 per day, and an average of 14,256,000 per month—which means twice this figure for two projectors.

It is well known that motion picture film will cut through anything, regardless of its toughness. The teeth of intermittent sprockets, particularly, have not been given fair consideration in this respect by projectionists or the trade generally when complaints are made that some types of intermittent sprockets become hooked in a very short time.

Change Framing Device Setting

There are 32 surfaces on the teeth of an intermittent sprocket which can be used to pull the film down and thus distribute the wear over all the teeth and lengthen sprocket life. But it is common practice now to set the framing device in about the central position, and since framing during projection has practically faded out of the picture, this position is rarely changed; thus only four teeth—that is, every fourth tooth each side of the sprocket—do all the work of moving the picture from rest during projection. The consequence is that these four teeth after a reasonable length of time become slightly hooked, and while they do not damage the film to any extent, set up a racket in the mechanism due to the sprocket hole leaving the hooked tooth.

Sprocket wear could be tremendously

reduced if the projectionist, say, once a month, slightly changed the setting of the framing device so that the sprocket turned one tooth. This would transfer the major load to the next tooth, and this procedure could be followed from time to time until each of the four teeth constituting a frame were at some time or another brought to the position where it takes the major load of pulling down the film past the aperture plate.

As you know, Simplex has practically eliminated wear of intermittent sprocket teeth through a completely hardened and ground sprocket made from tool steel on which even the teeth are accurately ground on both radii to an heretofore unheard of accuracy of accumulated error over all teeth not to exceed about .0001″. Due to the tremendous toughness of the teeth the wearing quality is increased tremendously when compared with the older type intermittent sprocket. This, of course, is only one of the many great strides that we have made in the perfection of this type of equipment. It required three years of research work and $22,000 for equipment to place this sprocket alone in production.

During the past year bearing and shaft tolerances throughout the Super Simplex mechanism have been considerably tightened up. All shafts are hardened and ground, and where lubricating difficulties might be encountered, spirals are cut therein to feed oil. The main drive shaft has been completely redesigned and constructed so that a well of oil remains in the center of the shaft, which eliminates the possibility of a bind-up in the bearing due to the tremendous strain placed upon it in starting the equipment with the type of drives recently adopted by sound reproducer manufacturers.

• Letters to the Editor •

Data on Projection Optics is Badly Needed

Most projectionists, including myself, have only a very hazy knowledge of projection optics, most of the stuff on which we have to dig out of tomes which wander all over the place. Why not include in I. P. a series of articles on optics conducted after the fashion of the step-by-step analysis of amplifiers series. There is not much point to articles on magnification ratio, lens speed, *etc.*, unless the fellows understand what these things are all about.

Some months ago I had an idea wherein I could cooperate with some of my friends to our mutual advantage. Once a month each of our group selects six questions relating to *anything* connected with projection, and the inquirer must know the answers to the questions he poses. The fine part about this is that in the search for answers to questions one invariably turns up considerable other valuable data.

If you know of any projectionists who would like to participate in this idea to the extent of six questions a month, and would publish their names, I would be grateful.

R. Thomas
7 Cranston Flats, 132 O'Donnell St.
Sydney, Australia

Mr. Griffin Writes a Letter—on This and That—But Mostly About Simplex Pedestals

I read with a great deal of interest the article "Aligning the Lamphouse with the Projector Mechanism," by A. C. Schroeder, of Local 150, L.A., in the June issue of your fine paper.

The article is excellently written, and the undoubted result will be that the boys will get busy and check their lamp alignment and find to their dismay that a tremendous proportion is out of line. However, they cannot accurately align their lamps even with the excellent instructions set forth and the tools described, because of the inaccuracies of the older lamphouse carriages and bases.

It was because we realized this difficulty that we placed on the market the Super-Simplex Pedestal and equipped it with a lamphouse carriage which is practically a universal joint in that it may be raised and lowered, swung from side to side, and tilted at any angle necessary to provide correct lamphouse alignment. This assembly, of course, is only one unit in the chain of many improvements incorporated in this pedestal which make possible prompt alignment on the screen both vertically and laterally, improved picture steadiness (due to the sturdy construction of the projector and soundhead support bracket) and excellence of appearance when installed, since all wiring may now be enclosed within the base proper.

I feel that a follow-up of Schroeder's article with the data on the new pedestal and tying the two articles together would be an excellent idea, and I believe the craft at large would welcome such information.

Herbert Griffin
International Projector Corp.

We, too, felt that the boys would appreciate this information on the new Super-Simplex pedestal (adv.)—so we published it in I. P. for March last, p. 16. Yep, a full-page layout of pictures and keyed type matter. Only recently Mr. Griffin told us he read each issue of I. P. from cover to cover. (For shame!) Just too close to the forest to see the trees, that's all. How we love to anticipate manufacturers on their own products—and particularly the vice-president of International Projecter Corp. (adv.).

Suprex Arc Negative Tip

Here's a little hint to pass along to the boys using Suprex arcs: From time to time a red cap forms on the negative tip which prevents striking of the carbon the second time and is hard and non-conductive. Instead of filing this tip off, I just wet the tip of a finger and touch this red tip, after which it mushrooms, turns to powder and drops off. The carbon is then O. K. to strike without trouble. Pass this along to the film grinders.

W. A. Crute
Vancouver, B.C., Canada

Practical Projection Hints

In answer to Gregory from "down under" (New Zealand, wasn't it?) he wrote in I. P. recently about trouble with his Suprex arc in spitting and sputtering (haven't we all?). It must be winter down there, so he first should make sure his carbons are dry by storing them on hot radiators. But he should by all means take a divider and measure arc gap when operating. It should measure no less than 5/16 or 9/32 of an inch. If the carbons are burned with a short arc gap, carbide tips will form and the arc will be unsteady due to molten drop of material changing resistance constantly, making surges and arc flare.

I was troubled by a bad batch of carbons, and sent samples to the factory. A belated answer stated that the carbons were defective and would be replaced.

Random thoughts: a good set of ear phones should be in every room. An outlet jack should be placed on the front wall in such a position that the cord will reach to anyone standing at either machine. It is easy to detect the slightest sprocket hole or frame line hum or any other noise. One can listen in while adjusting or remedying. Wiring through the hard-of-hearing amplifier and using a variable resistor to control volume, will afford a complete check on all equipment.

A good check is to take a piece of isinglass, scratch a grid iron pattern on it and insert over aperture on film track. Project light on to screen and start projector. If movement is discernible from the projection room, present set-up is undesirable.

How many projectionists have threaded a wrong reel or failed to drop a short during the supper hour? In the lower magazine and on the door in each projector, I have a card with reels marked in succession that will, or should be, threaded into that machine. Upon inserting reel in upper magazine, the film is never wound on lower spindle unless the reel number corresponds with preshow schedule. One cannot forget to drop a short, due to positive reminder. It takes only a few minutes to make an entirely new reel schedule for each change of program.

Most automatic rewinds transfer film from one reel to another at too high rate of speed and too noisily. The expedient of two new pulleys (one large and one smaller), with a V-belt to fit will be a sure cure in remedying both troubles. Oil drip pans similar to those on W.E. equipments should be made available for all types of heads and sound.

Roy J. Arntson
Minneapolis, Minn.

ARGON vs. MERCURY VAPOR TUBES FOR PROJECTION RECTIFIERS

By *J. K. ELDERKIN*
FOREST MANUFACTURING CORPORATION

Rectifier manufacturers have been deluged with complaints anent the performance of their products as a result of the insistence of projectionists upon substituting mercury vapor for argon tubes. The characteristics of these tube types, and their relative applicability to projection rectifier service, are set forth in the appended paper by an acknowledged expert in rectifier design and performance.

RECENT experiences with expensive repair jobs on projection rectifiers suggest this restatement of several important facts about the tubes used therein. I particularly want to warn against the use of tubes using mercury vapor instead of argon as the gas medium in the glass envelope, because the use of the former type will cause serious trouble in the rectifier itself and be the direct cause for rather expensive repairs.

To aid in a clear understanding of the subject it seems advisable to describe briefly the operating characteristics of tube types commonly used in projection rectifiers and to cite some causes of failure and their remedies.

We shall consider first the argon gas-filled type, with tungsten filament or cathode. This is the most widely used and best known rectifier tube in the industry, and is commonly called the "Tungar-type" because this was its trade name when it appeared on the market. It is being marketed at present by several manufacturers under different trade names, and will hereafter be referred to as "argon tube," to distinguish it from the "mercury tube."

Components of Argon Tube

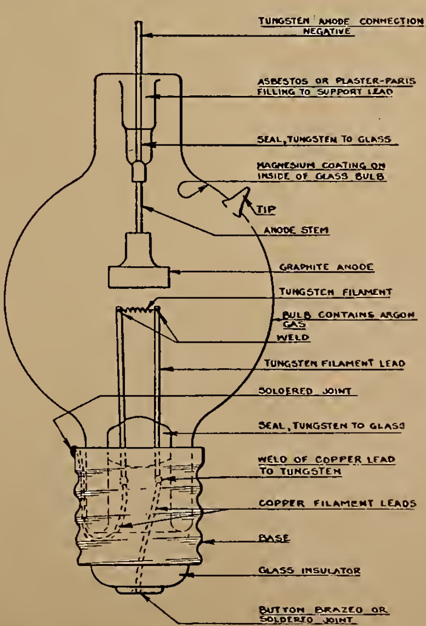
The argon tube consists of a hard glass (Pyrex) envelope in which is a filament of coiled tungsten wire supported by two tungsten wire electrodes. The two electrodes are used to carry current for heating the coiled filament, which in the case of the 15-ampere tube requires 2.5 volts and approximately 27 amperes. One of the electrodes, besides conveying filament current, also carries the main current being rectified, which may be an additional 10 to 15 amperes.

The filaments are supplied with current from separate low-voltage windings on the transformers, or, in some cases, from a separate filament transformer. The two filament electrodes are, of course, sealed into the glass envelope by air-tight glass seals at the base of the tube, and these terminate at the brass screw-type base (Mogul size).

Onto the top neck of the envelope is sealed a single tungsten electrode extending toward the filament, and to the lower end of the electrode is secured a graphite or carbon button which serves as the anode or plate electrode. The end of this electrode extending through the top of the envelope is sometimes the tungsten wire itself, or, in other cases, a flexible copper wire is welded to the tungsten for the purpose of making better contact to the terminal clip connection of the rectifier.

Usually there is a white plastic material surrounding the anode lead where it comes out the top of the envelope. This material is commonly thought to be an air-tight seal; but it is in no sense a seal, being merely protection to prevent over-flexing of the anode lead wire.

The glass tube thus built is carefully exhausted and the electrodes freed of gases as far as possible; after which a small quantity of pure argon is put in the tube, and the tubulation by which the tube has been exhausted is sealed. Before sealing off, a small quantity of



Diagrammatic representation of argon tube specifications

magnesium or other alkaline earth metal has been placed inside to be used as scavenger (getter). This scavenger metal is exploded or volatilized within the confines of the envelope by means of an internal or external heating means called "bombardment."

The purpose of the scavenger metal is to absorb or unite with deleterious or destructive gases that might later be given off by the electrodes, by the walls of the glass or in combination with the argon, thus keeping the contents of the envelope free from impurities that might render the tube inoperative.

The tube described is, of course, a half-wave rectifier and, briefly stated, operates as follows: The tungsten filament when heated to proper temperature gives off a stream of electrons, some of which collide with the argon gas molecules, thus giving a secondary emission sufficient to allow a flow of considerable current between cathode and anode.

The resistance to the passage of current through the tube in one direction is very slight; but its resistance to passage of current in the opposite direction is very high, so that it might be compared to a check valve in a fluid system, blocking the flow in one direction and offering little resistance to the flow in the opposite direction. Rectifier tubes thus have come to be called valves. This valve action was discovered by the late Thomas A. Edison and for many years was called the "Edison Effect."

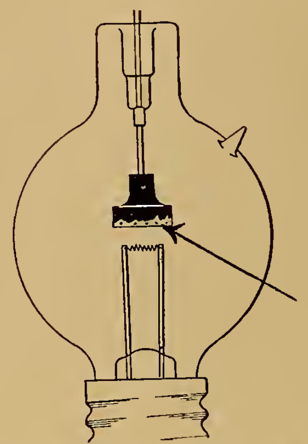
The Mercury Vapor Tube

The valve action of a rectifier will break down upon the application of a plate voltage higher than that for which it has been designed. This is called the "critical voltage." The critical voltage depends upon several factors, including the shape and number of electrodes in the tube, space between electrodes, operating temperature, and the kind and quantity of gas in the envelope. The critical voltage of the argon tube described is considerably lower, for instance, than a tube using mercury.

This brings us to consideration of the mercury tube designed to be used in place of the 15-ampere argon tube. Outwardly the two tubes are just alike, but the internal structure differs in the following respects:

Instead of the coiled tungsten filament

of the argon tube, an oxide-coated, or so-called indirect-heater, type of cathode is used. The cathode consists of a



Bulb with air leak or defective gas filling. Arrow indicates blue or white coating

metallic barrel plate, ribbon or screen of considerable surface area and coated with white oxides of barium or strontium, or both, and designed to be heated to a low red temperature by a coiled heater element in contact with it. Instead of argon gas, a small quantity of mercury is used, which when heated gives a slight mercury vapor pressure in the envelope comparable with the argon gas pressure in the argon tube.

In operation the oxide-coated cathode gives off a stream of electrons, the same as the tungsten filament first mentioned, but, of course, the electron emission from the oxide cathode is obtained at a much lower temperature. Electrons escaping from the cathode collide with gas molecules of the mercury vapor (similar to argon tube action) and large currents can be passed between cathode and anode.

Difference in Operation

In operation there is one very great difference between the two types of tubes: the argon tube is instantaneous in operation, that is, no time is required for the cathode to heat up and thus pass the plate current. The mercury tube, with its oxide cathode, requires that the cathode must first be energized and sufficient time elapse for it to become emissive before the plate current can be applied.

The purpose of this article, frankly stated, is to show why the selection of the mercury-type tube for use in place of the argon tube in a projection rectifier is a grave mistake and one to be avoided. I am not condemning a mercury-type tube, because in certain rectifiers and certain applications thereof a mercury tube would be proper, and, in fact, under certain conditions the only type that could be used successfully. However, a projection rectifier designed for argon tubes does not fall in this category.

A mercury tube intended to replace an argon tube in any rectifier should be very carefully considered from all angles before making the swap, otherwise costly troubles may ensue. In support of this opinion I offer the following anent rectifiers for projection:

1. The rectifier is designed with considerable reactance or inductance for smoothing the current and for limiting the arc-striking current, thus quite severe voltage surges are created upon loading or unloading the rectifier, and, to some extent, when sudden changes occur in load current. The only way this surge can be prevented is by opening the a.c. input to the rectifier tubes instead of breaking the d.c. output circuit from the rectifier.

When the mercury tubes are substituted for argon tubes in the rectifier. it is customary to break the d.c. output circuit to extinguish the arc and to leave the a.c. input alive in order to keep the cathodes of the mercury tubes heated. Operating in this way induces a surge in the rectifier which, passing into the transformer windings, causes the insulation of the transformer to break down, requiring an expensive repair or repiacement job.

With the argon tube, the a.c. input to the rectifier is opened to extinguish the arc (as it is not necessary to keep the cathodes energized as is the case with mercury tubes), therefore the surge is prevented and no damage is done to the transformer or tubes.

Protective Feature Lacking

2. The critical voltage of the mercury tube is much higher than that of the argon tube, which means that the mercury tube will withstand a higher peak inverse voltage than the argon tube.

When argon tubes are used in the rectifier and surges occur, due either to cutting off the arc on the d.c. side or to severe changes of load current at the arc, there will be no damage done to the transformer, because when the inverse peak voltage of the surge is high enough to damage the transformer, it is higher than the tubes will withstand, with the result that the valve action of the tube will be destroyed. With a properly designed rectifier, the instant the valve action of the tube is destroyed there will be an increased flow of current within the rectifier circuit itself, which will immediately snuff or supress the surge, resulting in no damage to either the rectifier or the argon tubes.

In all of the earlier rectifiers, and even in some rectifiers made today, the protective feature just described does not exist because, frankly, of lack of knowledge of how to incorporate that feature.

When mercury tubes are substituted for argon tubes this protective feature is destroyed. In rectifiers using argon tubes and having this protective feature, the worst that can happen is the loss of a tube due to a destructive surge. The replacement of a tube is a simple, quick and inexpensive remedy; whereas the repair of a transformer is not simple, requires time and, of course, involves considerably greater expense.

Substitution of mercury tubes for argon tubes in the aforementioned type of rectifier will cause breakdown of the transformer rather than breakdown of the bulb, because the mercury tube withstands high peak inverse voltage and passes this high voltage on to the transformer, as previously explained.

3. The rectifier is designed with proper filament windings for the argon tube filament requirements, and the available wattage is not sufficient, in my opinion, for the oxide cathode of a mercury tube of proper design to have an equal rating to an equivalent argon tube. Therefore, in designing a mercury tube to use the available wattage of the filament circuit of the rectifier designed for argon tubes, it is obvious that such a mercury tube will have insufficient cathode to assure even reasonable life.

There are other reasons why the mercury tube should not be substituted for the argon tube, but I believe sufficient data has been given to cause projectionists to consider carefully the aforementioned points and save much unnecessary trouble by using argon tubes for which the rectifiers are designed, and *not* mercury tubes.

Appended are a few pointers on argon tubes and their use which should be helpful:

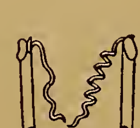
Argon Tube Pointers

A. The most common cause of early tube failure is leakage, caused by a minute crack in either the anode or cathode glass seal. If a tube is a "leaker" when you first install it and light the filament you will note an ap-

(*Continued on page* 26)

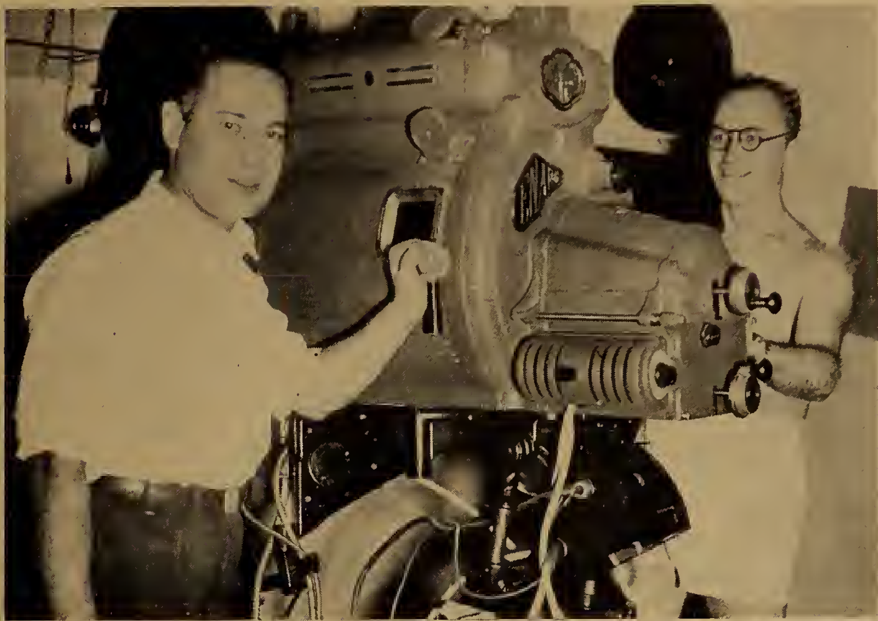
SHOWING VARIOUS STAGES OF FILAMENT DETERIORATION

Bulb run over 1000 hours



Bulb run over 4000 hours

Bulb reversed or flashed back



International News Photo

Wearing victory smiles, Morris Silver and Otto Rose (in shorts—what subtle propaganda), who introduced a new technique in organizing non-union theatres

New Organizing Wrinkle by N. Y. City Projectionists Via. Screen Talk

IT WAS a hot, sultry July night in New York City, the populace of which had fled their homes to nearby waterfronts, parks or movie theatres to escape the oppressive humidity. Practically the only satisfied people in the city were the resort concessionaires and the film exhibitors, for obvious reasons.

Particularly happy was the owner of the Greenwich Theatre on the lower west side of New York. The box-office had registered an unusually heavy first show, his film program had cost not too much, and his overhead was down to bedrock. Things were looking up, indeed, and would get much better as soon as he got around to wheedling another reduction out of those goniffs, the film distributors. Wholly unmindful of impending disaster, he stood at the rear of his well-filled theatre (Carefully Cooled) and mentally calculated the profits of the evening. All was serene.

His reveries were abruptly terminated by a break in the continuity of the screen image. "Damn those operators!" Halfway to the house telephone he was stopped by the house lights which flooded the auditorium. Then there issued from behind the screen not the dulcet tones of a Robert Taylor or a Clark Gable but the crisp, businesslike voice of one of his "operators":

"Attention, please: Ladies and gentlemen this is the motion picture operator speaking from the booth. There is no trouble with the equipment and no cause for alarm. I am using this means to protest to you against the inhuman working conditions in this theatre.

"I work 7 days a week, 11 hours a day, have no vacation, and no rest. I eat in the booth where the heat is sometimes unbearable. The management refused to listen.

"I designated Local 306, the Motion Picture Operators' Union, as my collective bargaining agent. I ask you not to patronize this theatre until they sign up with Local 306."

Gevalt! What was this? The boss pinched himself to make certain he was alive. But the only result was a repetition of that maddening voice from the screen: "Attention, please . . . " The boss took the steps to the projection room three at a time. Arriving there he threw himself against the door, mayhem in his heart. It was barricaded! From within came a voice telling him to go away and stay away, because the door was never going to open, not for days anyhow, or until he signed an agreement with Local 306.

The angry shouts of the audience below demanding refunds turned the boss' attention and person in that direction . . .

Two hours later when the dreadful business of refunding admissions was completed and the theatre cleared the boss took stock. That *this* had to happen to *him,* for the first time in the history of show business. But it had happened, and through the medium of his own equipment. Bitter reflection for some minutes opened up no avenue of escape. Turning sadly to his cashier, he said: "Sarah, I want you should call that union —what was it, 306's?"

And thus was added a new wrinkle to theatre organizing activities by two men who not only had no previous experience along that line but who did not even belong to a union. Their names and their features appear in the cut and caption above, for the sake of the record.

Of interest is the method employed in this case. The theatre in question had no p. a. system, and the boys themselves were conscious of their limitations of speech. So they took themselves to a commercial transcription studio and not only paid for the disc used but also made certain that their message would get over nicely by hiring a professional announcer to speak the lines!

[P. S.: The story and picture of this incident made the front pages of several New York newspapers, none of which thought to send the lamp manufacturer a bill for advertising space.]

QUESTIONS ACCURACY OF 'APERTURE HEAT' READINGS; SCORES I. P.'s CARELESS HANDLING

By *K. P. KENWORTHY*

IT MAY be of little practical importance, but in the interests of technical accuracy it should be pointed out that the phrase "the temperature at the aperture" has no meaning. The term keeps appearing in various discussions in I. P., and frequent attempts are made to measure this imaginary quantity by thermocouple or thermometer. This is similar to trying to measure electric current by connecting a condenser and expecting its charge to indicate current. The reading of a thermometer in the light beam is some indication of its "charge" of heat, and no more.

The temperature of an *object* at the aperture is measurable; the temperature of the opening is not. To have temperature, a thing must have the property of containing heat. The aperture is in the path of intense radiation, but it has no heat capacity, hence no temperature. To find the temperature of the air at the aperture it would be necessary to shield the thermometer from the radiation from the lamp. This is beside the point, however.

A thermocouple placed in the aperture will give a reading, certainly. But a physically different thermocouple or a mercury thermometer will give *an entirely different reading.* That is because an object placed in the aperture will go on absorbing heat from the arc until it reaches thermal equilibrium—that is, until it is radiating and conducting away as much heat as it is receiving.

The heat at the aperture can be expressed *only* in terms of the *amount of*

(*Continued on page* 24)

FUNDAMENTALS OF SOUND RECORDING AND THEATRE REPRODUCTION

By *FRANK T. JAMEY, JR.*

IN THE last instalment we discussed the nature of sound and explored fully the various characteristics of sound waves. In order to understand clearly the process of reproducing sound from film one should have a clear perception of the nature of electricity. In every substance there are a large number of small particles of electricity, all of the same size. These particles are known as *electrons.*

There are, in general, two classes of substances in which electrons are present. One class, such as glass, has the electrons so securely attached to the atoms of the substance that they can be broken loose only with great difficulty. These substances are known as *insulators.* The other class, which includes principally metals, contains a large quantity of free electrons which are not attached and can move about through the substance. Such substances are *conductors.* When the electrons move, we say that the metal conducts a flow, or current, of electricity.

The flow of electricity in a metal wire can be most easily understood if compared with the flow of liquid in a pipe. If the pipe be filled first with sand and then with water, the electrons may be likened to the molecules of the water and the atoms of the metal to the grains of sand. The electrons may be made to filter through the metal just as the water may be forced through the sand.

The 'Ampere Rate of Flow'

In the same way that the flow of water in a pipe is measured by the number of gallons which pass a given point in a second, so the flow of electricity along a conductor is measured by the number of coulombs of electricity which pass a given point in a second. As a matter of fact, a coulomb is a certain number of electrons, just as a gallon is a certain amount of water. The rate of flow of electricity of "one coulomb per second" is known as an *ampere rate of flow.*

There are a number of different kinds of electrical currents. Just as water forced through a pipe by the action of a piston-type water pump varies or pulsates, so may an electric current. A direct current is one that is unidirectional. An alternating current is one which alternates regularly in direction: it is a periodic current in which the changes in magnitude and direction are regularly repeated and in which the net flow in one direction along the wire equals the net flow in the other direction. With an alternating current the electrons move slightly back and forth past a fixed point, without anv gradual progression along the wire. A 60-cycle alternating current, generally used in power service, involves current changes of direction one hundred twenty times per second.

Just as it requires pressure to force the water through the pipe, so it requires pressure to cause a flow or current of electricity. We generally measure water pressure in terms of pounds per square inch; and we measure electrical pressure in *volts.* There are a number of ways of producing this electrical pressure, some of which will be described subsequently.

It has been found that a definite relationship exists between the pressure and current, so that if the pressure be doubled, the current would also be doubled. This ratio is known as *resistance* and is measured in terms of *ohms.* The resistance of a wire to the flow of electricity can be accurately measured. Such resistance causes the dissipation of part of the current as heat. The relationship of these terms is that:

$$\text{Resistance} = \frac{\text{Pressure}}{\text{Current}}, \text{ or}$$

$$\text{Ohms} = \frac{\text{Volts}}{\text{Amperes}}$$

It can thus be easily seen that if certain electrical apparatus requires a certain amount of current to run it, it is necessary that a particular size of wire (in terms of diameter of the metal conductor) be used, so that for a given pressure adequate current be permitted to reach the apparatus. In some instances the loss of current in a particular length of wire due to dissipation by heat must also be considered.

Practically all electric machinery depends for its operation upon the interrelation between electricity and magnetism. The generator, the motor and the transformer all depend for their operation upon the mutual effects produced between their electric and magnetic circuits. When an electric current flows along a wire there are evidences of its presence not only within the wire but also in the space around it. Inside the conductor, the electric current produces heating and chemical effects; outside the wire it produces magnetic effects.

It has been found that if an electric current is passed through a coil of wire wound about an iron core, a magnetic field is set up. If the iron core should be in the shape of a ring, and another coil is wound around the opposite side of the core, then an alternating current passed through the first coil would, through the action of the magnetic field, cause a current to be induced in the second coil. This is well-known as a transformer action. The characteristics and efficiency of such a device can, of course, be varied by the number of turns of each coil, the size and type of wire used, the shape and size of the core, and the type of iron used for the core.

If we should take a loop of wire and rotate it in a magnetic field, an electric current would be likewise induced in the coil. This induced current would also be alternating. The frequency and voltage of the current depends on the speed of rotation, the length of the loop of wire and other factors. This is the principle of a generator. If it is desired to generate a direct current, the current is drawn off the rotating coil through a commu-

MODERN THEATRE SPEAKER

Diphonic speaker system, comprising one cellular h.-f. unit and two l.-f. units with baffle. Overall depth 48". Speaker network in box for amplifier rack mounting.

tator, which is a rectifying device that causes the potential delivered by the machine to be unidirectional. The reverse action of such a machine is a motor. In this case the coil of wire carries a current in a magnetic field with the result that the coil is made to turn. By applying an alternating current to the coil it can be made to rotate continuously.

At this point we digress and consider the devices that are responsible for the transformation of sound waves into electrical waves, and *vice versa.*

Electro-Acoustic Transducers

The two fundamental elements which perform these transformations are termed "electro-acoustic transducers." The fundamental principles of such electro-acoustic transducers have been known for several decades, but until the introduction commercially of the vacuum tube these elements were too insensitive to be of much practical use. Since the introduction of the vacuum tube and the development of amplifiers, electro-acoustic transducers have been developed to the point where they can now be made to operate with extremely high efficiency.

The microphone is an electro-acoustic transducer which is actuated by a sound wave and creates an electrical wave of a form exactly similar to that of the sound wave. The characteristics of the sound waves which are directed to the microphone are too well-known to I. P. readers to require repetition.

The microphone which has been perfected in the last few years and so universally accepted as a new standard for both high-quality sound recording and sound transmission, is the ribbon of velocity type. The outstanding characteristic of this microphone is its ability to respond uniformly to a very wide range of frequencies. In addition, it has certain directional characteristics which are of great value under certain conditions. It consists essentially of a light corrugated metallic ribbon suspended in a magnetic field and freely accessible to air vibrations from both sides.

Similar to an electric generator, when the ribbon is caused to move in its magnetic field, which is created by a permanent magnet, a voltage is set up in the ribbon causing electrical waves to be created in the circuit which are similar in form to the sound waves. This type of microphone appears to respond uniformly to frequencies in the range of 30 to 10,000 cycles per second over an angle of approximately 45 degrees on either side from the axis to the ribbon. Thus, by spacing any number of these microphones desired in a straight line about seven feet apart, uniform pickup of all frequencies may be easily accomplished on either side.

Its directional characteristic makes it more sensitive within the 90-degree angle on either side, permitting longer distance pick-up. It can also be placed so that its insensitive side may be directed toward acoustic reflections or other noises which it is not desired to pick up. Such a microphone can be located at some distance from its pre-amplifier which makes it easy to handle.

More recently an unidirectional velocity microphone has been perfected, which is similar in general design but sensitive only on one side. Thus all noises on one side are not picked up, which for certain conditions is very desirable.

We have seen how sound waves can be transformed to similar electrical waves which are, of course, very minute and only useful if they can be efficiently amplified. We have also considered some of the problems involved in picking-up all of the frequencies that are created with uniformity, and discriminating among those not desired so that the sound track should contain as perfect a record of the desired sound as possible.

Let us now consider the other electro-acoustic transducer which converts the electrical waves to similar sound waves and is known as a loudspeaker. Here many of the problems considered in connection with microphones are similar.

Modern Theatre Loudspeaker

While there are several types of loudspeakers, we will discuss only the moving-coil type, which is used now almost exclusively in theatres. In such a loudspeaker a voice coil is mounted on a cone and suspended in a magnetic field. Similar to a motor action, in this case when the electrical waves are passed through the voice coil in the magnetic field the whole cone is made to move and set up vibrations in the air, causing sound waves similar in form to the electrical waves. The efficiency of the loudspeaker depends almost entirely upon the mass of stiffness of the cone.

The reproduction of sound in theatres calls for a special type of loudspeaker of very high efficiency and power handling capacity, as well as one with directional characteristics which will permit the auditor in each and every seat to receive sound of an equal quality and of such quality as to be similar to the original sound.

The horn-type loudspeaker is particularly suited to meet these requirements. A horn is an acoustic transducer consisting of a tube of varying sectional area by means of which it is possible to radiate a considerable acoustic power into the air. This is due to the fact that the horn acts as a matching device which couples a relatively heavy diaphragm to the light sound medium. To obtain high efficiency it is desirable to have the cone work against radiation resistance instead of inertia of the cone itself. A horn for a paper cone, moving-coil type speaker unit may be designed with a large throat and a rate of flare and length which will permit suitable directional characteristics and efficiency.

The low-frequency cut-off of such a loudspeaker rises as the length decreases which makes it desirable to have the horn as long as possible (ten feet). However, practical limitations of space available behind the screen must be considered. As a result, two types of loudspeakers are today in use.

One type is designed especially for the reproduction of the lower frequencies (40 to 400 cycles per second). Since these frequencies radiate rapidly, it is not necessary to give much consideration to the

New Hertner Brush Gauge A Highly Useful Tool

A new and highly useful accessory tool, known as the Transverter Brush Gauge, has been developed by the Hertner Electric Co. The gauge is made to facilitate setting the brushes at the proper angle to the commutator. It is designed for a 35° angle, and will set at this angle when used with brush holders having a 1/16 effective thickness of brush holder box and with ⅜″ thick brushes with commutators, including 7″ diameter and ½″ brushes for larger diameter.

For use, determine the diameter of the commutator, set the pointer to this diameter, hold the gauge against the commutator as illustrated, then set the brush angle such that the brush holder guard is in line with the straight edge of the gauge. If the brush thickness does not correspond with the settings on the gauge, compensation can be made for use of ½″ instead of ⅜″ on the smaller size commutators by inserting a 1/16″ spacer between the gauge and brush holder when making the setting for the first brush holder. Then remove the spacer and alter the pointer position to compensate for the removal of the spacer.

Using the Transverter Brush Gauge

This gauge may be used on any motor or generator to set all the brushes at the same angle. Having all brushes at the same angle is absolutely essential, whether this angle be 35°, 30°, 15° or radial, depends upon the design of the unit and the brush holders.

The gauge is available direct from Hertner at Cleveland, Ohio, for $2.50, postpaid.

directional characteristics of such a horn. To prevent backstage reflections and unintelligible speech in the auditorium, and to ensure very high efficiency, it is necessary to load the cone of the two units employed with a folded horn.

The other type of loudspeaker is for the higher frequencies (400 to 10,000 cycles per second). Here the problem is not so simple. The higher frequencies radiate at a small angle. For practical reasons, it is not desirable to have a large number of sources of sound. Therefore, to insure high efficiency and wide distribution of the higher frequencies a horn has been developed for two units consisting of a number of small horns moulded together with their axes passing through a common point, their number (usually 15) depending on the size of the theatre. Each unit acts as a separate horn directing sound to a particular portion of the house. However, when added all together the result is uniform distribution of the wide range of frequencies with high efficiency. Considerable work has been done on various types of moving coil units to achieve best results.

Where a combination of these loudspeakers is employed, a baffle is usually built around them. Such a baffle is employed to increase the acoustic path between the front and back of the speaker unit. Thus, any sound which may issue from the rear of the unit and be reflected toward the auditorium, is delayed so that its effect on the direct sound is minimized.

The two electro-acoustic transducers which, on the one hand, convert sound to electrical waves, and on the other, convert electrical current to sound waves, are very similar in design and operation. In both cases the sound waves are directed over a large area and need to be picked-up or created by a relatively small area which very much complicates the problem.

In both cases, the electrical currents involved are very small, thus necessitating delicate apparatus. The vital necessity for high efficiency—that is, the transformation of all of the frequencies *uniformly* without the introduction of extraneous sounds—requires considerable refinement in the design of such equipment.

We will now consider another phase of the nature of electricity.

Edison discovered that if a cold metal plate was placed in an electric light bulb, and a potential was applied between them, a current could be passed between the plate and the heated filament. This can be explained by the fact that as the metal of the filament is heated, the free electrons, which are in the body of the metal, move faster by reason of their heat velocity. In fact, if the temperature is sufficiently increased, some of the electrons will move so rapidly that they will escape from the body of the metal and fly out into space.

This effect is exactly analogous to that of the evaporation of a liquid. When such a liquid is sufficiently heated, some of the molecules, by reason of their heat motion, acquire enough speed to be able to escape from the surface. In just such a way are we able to "evaporate" electrons from an incandescent filament.

If the filament is made negative with respect to the cold plate, the electrons will pass from the hot filament to the plate. This constitutes an electric current. When the plate voltage is small, only a few of the electrons evaporated from the filament move over to the plate, the remainder returning to the filament. As voltage is increased, however, larger and larger numbers of the electrons move over to the plate—that is, the current increases. This can be increased up to a saturation point. The saturation point can be raised by increasing the filament current. The greater the vacuum between the filament and the plate, the better it works.

DeForest placed a third electrode in a thermionic tube and obtained remarkable results. This third electrode is in the form of a grid located between the filament and the plate. When a voltage is established between the filament and plate in such a three-electrode tube, the electrons in their flight leave the hot electrode, pass between the meshes of the grid, and finally arrive at the plate. A small change of potential between the grid and filament will then greatly affect the electron flow. A small change in grid voltage will cause a large change in the plate current. If, then, we apply an alternating current to the grid of such a vacuum tube, the resultant plate current will vary in just the same way that the input does, but its variation will be of much greater amplitude.

Vacuum tube amplifiers and photoelectric cells will be the topic discussed in the next instalment.

So that the reader may determine how well he has absorbed the data presented in the foregoing article, there are appended six questions which will serve as a rapid review:

1. What is the difference in characteristics between insulators and conductors?
2. Define the following terms: Ampere. Volt. Ohm.
3. What is the well-known fundamental relationship between the three terms referred to in question 2, known as Ohm's Law?
4. What are the two electro-acoustic transducers described, and what is their function?
5. What did Edison discover about an electric light bulb that was important in the development of the vacuum tube?
6. In what respect did DeForest contribute fundamentally to the perfection of the vacuum tube?

CRAFT DUTY ON EQUIPMENT

Nobody is better qualified than the projectionist to drive home to the manager or owner the importance of improved equipment and to cite the probable ill effects on the box-office of inferior reproduction as contrasted with the high quality now being attained by the circuit houses. Here, surely, is competition with a vengeance, and the independent exhibitor must put his hands up in self-defense. The task of spreading this doctrine of improvement is strictly one for the craft, which is always better informed on technological progress than anyone else in the theatre.

SUPPLY FIELD NOTES

NEW G. E. INTERCOMMUNICATING SYSTEM FOR THEATRES

General Electric's radio division in Bridgeport, Conn., announces development of a new intercommunication system suited to film theatres and their executive offices. Essentially a loud speaker phone system, the new apparatus consists of one master station and from one to four remote speaker-phone stations. Latter may be located at any distance within 2,000 feet of the master unit without special arrangements. Therefore, theatres far within this distance measurement, can utilize the system in its essentially manufactured state.

NEW RCA SPEAKER COVERS AREA OVER 1 MILE

A powerful new loudspeaker capable of projecting speech and music upwards of a mile with full clarity was demonstrated by RCA Victor engineers as a valuable new means of promoting safety on Atlantic City's beaches.

The new "sound projector" utilizes only 100 watts of amplification. Heretofore, power speakers have required almost five times as much power to cover similar distances with far less intelligibility. Its remarkable distance range and tone quality is made possible by the development of what is probably the world's largest permanent magnet ever made for the purpose. It weighs 25 pounds and measures 8½" in diameter. This powerful magnet actuates a new type of molded diaphragm especially designed to withstand the terrific pressure of the sound, and which is impervious to all types of weather conditions. A new throat construction acts as an acoustic transformer of the mechanical vibrations into sound vibrations, and makes possible a remarkable clarity and uniform distribution of sound in the audible range of from 100 to 7000 cycles. The complete unit is 40" high and 20" in diameter.

WHOLESALE'S BOSTON STORE

Wholesale Radio Service Co., Inc., added another link to their growing chain of modern establishments with the opening of their beautifully fitted display and salesroom at 110 Federal Street, Boston, Mass., with Michael Scott, well known radio merchandiser, in charge.

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

DIVESTMENT of Erpi by A. T. & T. within the next six weeks was confirmed recently by officials of the former company. This move is in line with the oft-repeated statement of Walter Gifford, telephone head, that A. T. & T. interests should not extend beyond the communications field, and would not in the future. The F. C. C. investigation into Erpi sound-picture field practices is believed to have influenced this decision.

A. T. & T. will retain its sound picture recording interests, of course, which work will be handled by a skeleton staff in Hollywood. But it is all through in the theatre reproducer field.

Repeated efforts to dispose of Erpi have been made within the past two years, but up to the present no plan has been worked out. I. P. announced in August 1935 that A. T. & T. had tried to interest Atlas Corp. in Erpi, with a ready-made outlet for the latter's products existing in Paramount and R. K. O., in which Atlas had substantial interests. This deal fell through.

Subsequently Erpi tried to interest a coalition of exhibition interests—Paramount, Warner, and Loew—in such a deal, concerning which several meetings were held, but this also failed to click. More recently Erpi was offered to International Projector Corp., which already had extensive interests in the theatre equipment field. The latter shied away from the offer, preferring instead to dicker for a manufacturing license. It is believed that such a license deal has been signed.

Latest reports have it that a group of Erpi employees—said to include Charley Bunn, general sales manager; Mike Conrow, operating manager, and others—would try to obtain sufficient financing, possibly from A. T. & T., to continue the business on their own. This group is understood to feel that there is a market for about 1500 reproducing systems a year, plus the ever-widening educational field. Considerable doubt exists that this deal will go through.

Some reports have it that RCA would step in and take over all Erpi theatre-field interests, thus giving the former the strongest possible set-up. Such a move, however, might give rise to charges of monopoly on the part of RCA, a situation that would not be relished by Camden. Of course, if W. E. should license at least one other manufacturer (say, International Projector Corp.), it might be possible to swing the RCA deal. I. P. is able to say, however, that RCA wants no part of any such arrangement. In fact, at present RCA is seriously considering making a present of its theatre servicing contracts to any group that feels able to handle the work and show a profit. Servicing has never netted RCA a profit, particularly within the past two years when service rates have declined sharply.

A W. E. license would put International Projector Corp. in a very strong position. Already dominant in the projector field, and through General Theatres Equipment Co. having extensive interests in other projection accessories, International could use the branches of National Theatre Supply for not only distribution but also for servicing of sound equipment. This closer touch with a still wider group of customers would help considerably all units of G. T. E.

Whatever disposition is made of Erpi, it is obvious that the company will not be permitted to proceed on its present basis of direct affiliation with A. T. & T. Some observers see the outcome as another Graybar plan, through which W. E. disposed of its distributorships on what was termed an "employee sale" transaction. It is felt, however, that with the cream having been taken off the reproducer market, W. E. is interested now only in the recording licenses, the income from which is substantial enough to warrant proceeding, and the administration of which means a comparatively small overhead.

Chief bar to Erpi sale thus far has been reluctance of possible purchasers to assume huge total of contingent liabilities—suits, etc. Erpi has been settling latter as fast as possible.

Par. Ups Theatre Holdings

Paramount theatre affiliations have been increased by approximately 400 houses since the completion of the company's reorganization two years ago, it was learned yesterday. At the time of the reorganization in July, 1935, Paramount listed 1,036 theatres which were either wholly owned by itself or subsidiary companies or in which it had some financial interest. Thus, the increase in the company's theatre affiliations since the filing of that report brings the company's theatre interests up to a total of approximately 1,400 houses.

The greatest number of theatres affiliated with Paramount at any one time was 1,790. This total was reached in 1931, a year prior to the company's decentralization program and two years prior to the company's bankruptcy. During the Paramount reorganization approximately 800 theatres were dropped, either by cancellation of leases, outright sale or expiration of operating or lease agreements.

Krouse New Gen. Sec.-Treas. of I. A.; Retains Present Post

Louis Krouse, for many years assistant president of the I. A. T. S. E., has been named General Secretary-Treasurer, succeeding Fred J. Dempsey, who died recently. The appointment was made by the General Executive Board at its recent meeting in Seattle, Wash. Present indications are that Krouse will function in both capacities.

Krouse enjoys a wide acquaintance among officials of affiliated I. A. Locals, because it is through the office of assistant president that the innumerable details of organizing work flow. He is also president of Philadelphia projectionist Local 307, a post he has held for many years.

Gatelee Heads Mass. A. F. of L.

John Gatelee, business agent of Springfield, Mass., projectionist Local 186 and I. A. representative in New England, has been overwhelmingly re-elected president of the Mass. State Federation of Labor.

Best Loew Year Yet

Loew's is expected to show a net profit of approximately $14,500,000 for its fiscal year ending August 31. This will amount to at least $9.50 per share on common stock. Stock has already earned $7.20 this year. Unofficial estimate of about $14,500,000 would give company one of its best years on record.

Rising Production Costs Means Higher Admissions, Says Zukor

The rising cost of production must be reflected in higher admission prices at theatres, said Adolph Zukor, Paramount head, in a recent statement. The public wants personalities in big productions, the cost of which is constantly increasing all the time, continued Zukor. When reminded that pictures are the only things that increase in cost from year to year, while other products, such as automobiles, decrease in price, Zukor replied that Ford, for example, makes only one model a year, while a large producing company makes fifty or more different models a year.

250,000 Exposures a Second

The German Film Bureau has shown pictures of bullets striking armor plate taken at the rate of 250,000 exposures a second. This is a great advance over last Fall, when a shooting frequency of 80,000 exposures a second was demonstrated. Details of method and apparatus used are a military secret. It was learned, however, that the exposures are made by using a series of electric sparks with a stationary photographic plate

rather than with film. Bureau is now working on frequencies of nearly 1,000,000 a second and that it is theoretically possible to increase the frequency up to 5 to 10 millions exposures a second.

International Projector Outing

Nearly three hundred employees of the International Projector Corp. attended the twentieth annual outing of the company at Semler's Midland Park, Grant City, Staten Island, N. Y., on August 21. The older and newer factory employees again met the officers and office staff on the same informal basis which has kept alive the friendly spirit that has existed for a quarter of a century.

New Color Print Titles

United Artists, in association with Technicolor technicians, has developed a new plan for superimposing titles on films for foreign markets. Under the plan, titles are printed between frames so that they are projected below the picture on the screen. This necessitates dropping the masking of the screen one foot so that the titles are underneath the scene instead of on it. All companies will be invited to use the method as an industry development. A test screening will be held soon. The plan also requires that exhibitors change apertures slightly.

QUESTIONS ACCURACY OF I.P. APERTURE HEAT READINGS

(*Continued from page* 19)

heat per second flowing through the aperture. This flow of heat, absorbed by the film, will raise its temperature to the ignition point, if enough time is allowed for sufficient absorption. Incidentally, dense film will ignite sooner than clear film because some of the heat is transmitted through clear film, unabsorbed.

An analogy to the flow of heat is amperage, the flow of electricity in coulombs per second. Flow of heat is expressed in calories per second. It can be measured by placing something of known heat capacity in the light beam at the aperture to absorb the heat flowing at that point, and noting the rise in temperature over a known length of time.

I once described, in a letter to I. P., an aperture calorimeter which measures the quantity directly in calories per second. I agree with the judgment of I. P.'s editor that it is of little practical use in the projection room, but it nevertheless gives the only reliable means of comparing aperture heat in the only units that can be used to express it.

Dr. Hardy of Massachusetts Institute of Technology will verify my contention. Note that he measured the temperature of the *aperture plate*, and not the aperture.[1] He also tried the thermocouple in the light beam at the aperture to see how high it would go, but he avoided saying that the reading showed the temperature at the aperture. Dr. Seyer of the University of British Columbia was either misquoted in I. P. for July[2], or he failed to consider a most elementary point in thermodynamics.

Aperture Heat vs. Manpower

You may consider this purely academic, but I think that I. P., a technical journal should not be less accurate in dealing with the danger point in the pro-

jection room (aperture heat) than with the more familiar and more generally understood applications of physics. Aperture heat is our most potent argument for two-men shifts. It would be foolish to build up a case on aperture "temperature," which the opponents could blast with the statement: "It is not measureable. No one knows how fast film will ignite in a projector. There are fire shutters on the machines, and we don't have film breaks any more."

I recently measured the time it takes film to ignite from my low-intensity lamps. The exposure was controlled by a disc revolving at known speed (checked by stroboscope) between the lamp and the film, with a notch in the disc to allow light to pass. The size of the notch limits the time of the exposure. Opaque news stock ignited in 1/6 second in a slightly warm film trap. The heat at the aperture was previously found to be a maximum of 22 calories per second. The very weakest Suprex Lamp will deliver at least twice this heat to the aperture.

Consider the result if a projector is operating with aperture heat of 30 calories per second, which will ignite film in ⅛ second. Many will be found with much more heat. Suppose a motor fuse goes out, or something else causes the motor to fail. The exposure of each frame to the light increases from 1/24 second to ⅛ second before the fire shutter drops. The film inevitably fires and is pulled into the lower magazine—unless there is a man there to close the dowser, which there wouldn't be on a one-man shift.

I am enclosing a clipping that was exposed for 1/6 second in a *cold* film trap, by way of proving that my exposure really is controlled. Needless to say, the sample that ignited completely is not available for display. I know that my fire shutter argument is far from air-tight. Fire shutters can be weighted. Nevertheless, quantitative data are more convincing than talk or mere assumption.

Mr. Kenworthy's contribution opens up a vast field for speculation, only the boundaries of which will be skirted at this time. That his exposures are "controlled" is apparent from the sample film clips submitted, reproduction of which is impossible because of their physical condition. An exposure of 1/6 second, under the circumstances, certainly is no mean accomplishment for a lone worker in the field.

Considering the other and larger aspects of Mr. Kenworthy's contribution, including his criticism of both the "experts" and I. P.'s own handling of this topic of aperture temperatures, we still consider the matter one of purely academic interest. That nitrocellulose film will ignite when exposed to heat from a carbon arc is no longer news. Is the period of exposure—what fraction of a second—of any great importance? As a

[1] I. P. for October, 1936, p. 24.
[2] I. P. for July, 1937, p. 21.

matter of academic interest—yes; as having an important bearing on manpower requisites —emphatically no!

Mr. Kenworthy submits for inspection a film frame exposed, by means of his controlled method, to a heat of 22 calories for 1/6 second. (This with a low-intensity lamp; other type lamps have much higher heat ratings.) The frame is charred, crisp and curled, but is not burned through. This frame, incidentally, was exposed in what is termed a "cold" film trap. All of which is very interesting, of course, and undoubtedly a valuable contribution to projection literature, along with the experiments of Drs. Hardy and Seyer as cited in the foregoing article.

Beyond all this, however, is the fact that there exists no danger of film fires when a projector in good working order passes film through the aperture at the standard rate of 90 ft. per minute (each frame being at rest at the aperture for 1/32 second), irrespective of the light source used. But what has all this to do with manpower requisites? Absolutely nothing, for the simple reason that on a one-man job the projectionist is away from the projector not for a second or a fraction thereof but for *minutes* at a stretch. Whether film ignites before an arc in one second or any fraction thereof is wholly immaterial in a one-man projection room. When we employ the term "one-man shift," every reader knows that the projector is left unwatched for minutes at a stretch throughout the day. Introducing the element of seconds, or fractions of a second, into any such discussion is among the most futile activities extant.

As has been pointed out repeatedly in these columns, I. P. has never subscribed to the theory that the possibility of a film fire is 90 per cent of the reason for the presence of an experienced projection crew in the room; nor has it ever exhibited any patience with that portion of the craft who, persistently yelling "Fire!" seek to change the craftsman's status from that of projectionist to fireman. A properly projected picture, with all that it entails, requires vastly more skill than a good pair of eyes ever alert for an aperture fire.

Mr. Kenworthy is deserving of praise, of course, for his independent experimental work, more of which by members of the craft undoubtedly would contribute greatly to the clarification of existing projection problems.—Ed.

ARGON vs. MERCURY VAPOR RECTIFIER TUBES

(*Continued from page 18*)

parent smoking of the filament inside the envelope, and shortly the filament will disintegrate until it open-circuits. Upon examination, you will note that the carbon anode is coated with a white soot and sometimes has bluish-white streaks. A tube showing this sooty deposit, whether its filament lights or not, is a "leaker" and, of course, will not function as a rectifier.

B. A "hard" tube is one that will not readily pick up its load: the filament lights but the tube will pass little or not plate current. The cause of this usually is aging, that is, the tube has been used so long that the filament has sagged into a long half loop instead of being fairly straight, with the result that the filament is stretched out to almost double its original length. When the coils of the filament are close together, the 2½-volt supply will heat the filament to a sufficient temperature to be highly emissive. But when the filament stretches out far enough, the area for heat dissipation is increased to such an extent that the temperature of the filament is not then high enough to be as emissive as it should be; consequently, the loss of emission prevents the tube from passing its full plate current. A tube in this condition should, of course, be replaced.

C. A flash-back tube is one in which the valve action has been destroyed due to too high a maximum inverse peak voltage being applied to the tube. This is usually caused by a surge created when breaking the load circuit, such as extinguishing the arc by opening the arc switch and leaving the a.c. circuit alive.

In a properly designed rectifier this flash-back will not occur, due to the protective measures employed; but in those rectifiers where it does occur, there is only one remedy to stop it: leave the arc switch closed all the time or cut it out of circuit and then turn "on" and "off" the rectifier from the a.c. side,

either by wiring the a.c. supply through the table switch to the a.c. input of the rectifier and connecting the d.c. directly to the lamp, or else by wiring-in a remote control switch and relay in the a.c. supply.

To distinguish a tube that has flashed back and become inoperative: you will note a hole sucked in the side of the glass envelope in some cases, or else the filament electrode will be melted down with a ball on the end and the filament partially or completely melted away.

D. Just because a bulb filament lights is no indication that it is operative, because it still may pass no plate current due to being either a leaker or a hard tube. Always try a tube known to be good before looking elsewhere for trouble.

E. The quantity of light emitted from a tube with its filament energized will vary in different tubes due to the differences of density of the scavenger metal deposited on the glass walls of the envelope. This should not be considered as due to a filament defect or insufficient voltage.

F. To determine whether the argon tube is rectifying—that is, whether it is passing plate current—look into the bulb with the rectifier in full operation and observe whether or not there is an arc of blue light between the filament and anode. If the tube is passing plate current, there will be a bluish arc between anode and filament very easily distinguished from the white light of the filament. Another check-up is to remove the clip from the suspected tube while the rectifier is in full operation. If the tube is working, there will be a spark between the pinch clip and the anode terminal as they are contacted; if not working, there will be no spark.

TYPICAL TROUBLES IN NEW SOUND REPRODUCING SETS

(*Continued from page* 15)

full attendance, one-half the audience cannot hear the show.

Replacing the resistor requires from 5 to 15 minutes. The protecting screen must be removed, and there are other mechanical difficulties. When trouble developed no one had time to make the change immediately, and half of the speakers were inactive for about an hour. On other occasions when the stock of spares was exhausted, the audience listened to decidedly inferior sound for a period of several days.

The management, not knowing what to do about it, tolerated this state of affairs. No member of the projection staff, who should know the answer, ever recommended that a larger cage be installed and that resistors or groups of resistors that would carry the load be

put in. Everyone concerned seemed perfectly satisfied with buying plenty of resistors, watching them blow out, and putting in new ones to blow out again in turn.

Haphazard Replacement Dangerous

Case 6. An inspection made in the same theatre, to determine if there was any reason for this resistor trouble other than that they were working at capacity, revealed another condition eloquent of carelessness and poor practice.

At some indefinite time in the past an amplifier condenser had been replaced, not by an exact duplicate but by a nondescript part which was electrically satisfactory but mechanically of the wrong size and shape to fit in the allotted space. The replacement was simply "stuck in" where space allowed and mounted precariously by a single soldered connection. The bracket from which it hung had sagged with time, and the part appeared in imminent danger of breaking loose and falling onto the unprotected terminals of the power transformer.

A bit of dried-out tape was found at the bottom of the amplifier, and traces of tar were visible on the condenser casing. At one time, seemingly, mechanical support had been provided by a single turn of friction tape, which naturally had dried out in the heat of the amplifier and fallen off. A very brief inspection of the amplifier interior showed an easy and reliable method of anchoring the same condenser firmly to a nut-and-bolt support. This was done. Why had it not been done originally? place?

One of the crew thought he recalled the origin of the condition. The replacement had been made in an emergency and in the quickest possible way. Obviously, no one had bothered to go over the job thereafter and put it right.

Cases 5 and 6 illustrate two self-evident flaws in projection room practice, which may be added to those already cited:

f. Considering a repair complete after a temporary cure has been effected, without taking reasonable precautions against a recurrence.

g. Considering a haywire repair (in itself justified by emergency conditions) to be complete without re-checking and

changing haywire work to permanent work.

Case 7. The Palace Theatre, Broadway, N. Y. City, developed an aperture fire several weeks ago. A projectionist (?) opened the projector door, and for good measure also opened the soundhead door—and threw a bucketful of sand into both!

HOT FUSES: TROUBLES AND THE REMEDIES THEREFOR

(*Continued from page* 8)

wire is secured. This, and the lug also, must be flat. These parts are usually far from flat, the lugs being *very* bad, but being soft and of lighter stock, they often draw down to make a fairly good contact.

In Fig. 5 we have a clamp on each end of the lower fuse, placed there in an effort to reduce the temperature by improving the contacts, which they did. This fuse had been giving more or less trouble. Notice that the upper fuse has no clamps. No trouble was experienced with it, even though it was situated immediately above the hot fuse, and must have absorbed some heat therefrom. It was quite evident, therefore, that something was wrong below, especially when the current was only 67% of the fuse rating. Notice that there is a metal piece between the clamp at the left and the fuse clip, both above

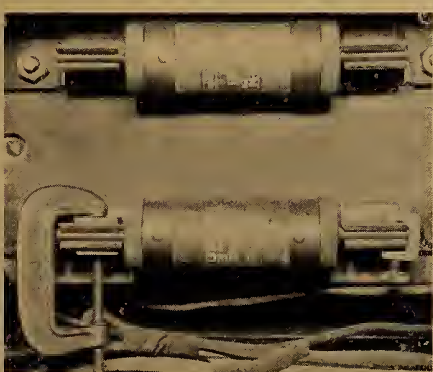


FIGURE 5

and below, which is to distribute the pressure evenly over the entire surface. The clamp at the right has not been treated in a like manner, and while it improves the contact it is not as good as the one at the left.

These contacts have since been corrected, and it is now possible to draw nearly the full rated current with so little rise in temperature that the parts are practically cold. This without the clamps, of course.

Some projectionists have improved on the clamp idea. A hole is drilled through the fuse clips and a bolt with a thumb-nut is put through it. The ends of the fuses are then slotted so that they can be inserted by only loosening the thumb-nut. While this is more convenient than the

clamp, it reduces the area of contact by the amount of metal that is removed for the hole and the slot. If such a course is taken, heavy brass washers should be put under the bolt and under the thumb-nut to distribute the pressure. However, it is far better to get at the seat of the trouble, thus rendering such measures unnecessary.

Figure 6 reveals an unpardonable tactic. Of course, no one ever doubles up the fuse links. However, you may as well know the approved method, if you *must* resort to this. The usual procedure is to place two (or more?) fuse links together, place the screw through them and fasten the assembly to the end-piece. Frequently not even a washer is used. The accomplished culprit will put one fuse link *above* the end-piece and the other *below*, thus securing two contacts, one for each link, which will assist in carrying the extra villainous current. Place a heavy brass washer outside of *each* link and fasten securely. There is nothing like committing the perfect crime while you are at it.

Even when complying with the law and using only one link, it should be done properly, because heat will be produced here just as well as on the outside; only here it is much closer to the link that burns out and it is confined, retaining more heat than it otherwise would. The piece to which the link is bolted is usually quite flat, thus assuring a pretty good contact.

Slight imperfections do no harm if the link is fastened *very* tightly, as the softer metal of the link will conform to the shape of the other piece, and the area of contact will be a trifle more than it would be if perfectly flat. It does no harm, though, to run the file over the contact surface of the end, to make sure of its condition, but be careful not to rock the file. If no washer is used, you will have a contact only the size of the screw head, which is not sufficient. Use a heavy *brass* washer; you want it to be a good conductor.

There are a couple of emergency measures that may be used when it is known that a fuse is about to go. Sometimes one can smell hot fibre, and a hand placed cautiously on the various parts of the circuit will locate the cul-

FIGURE 6

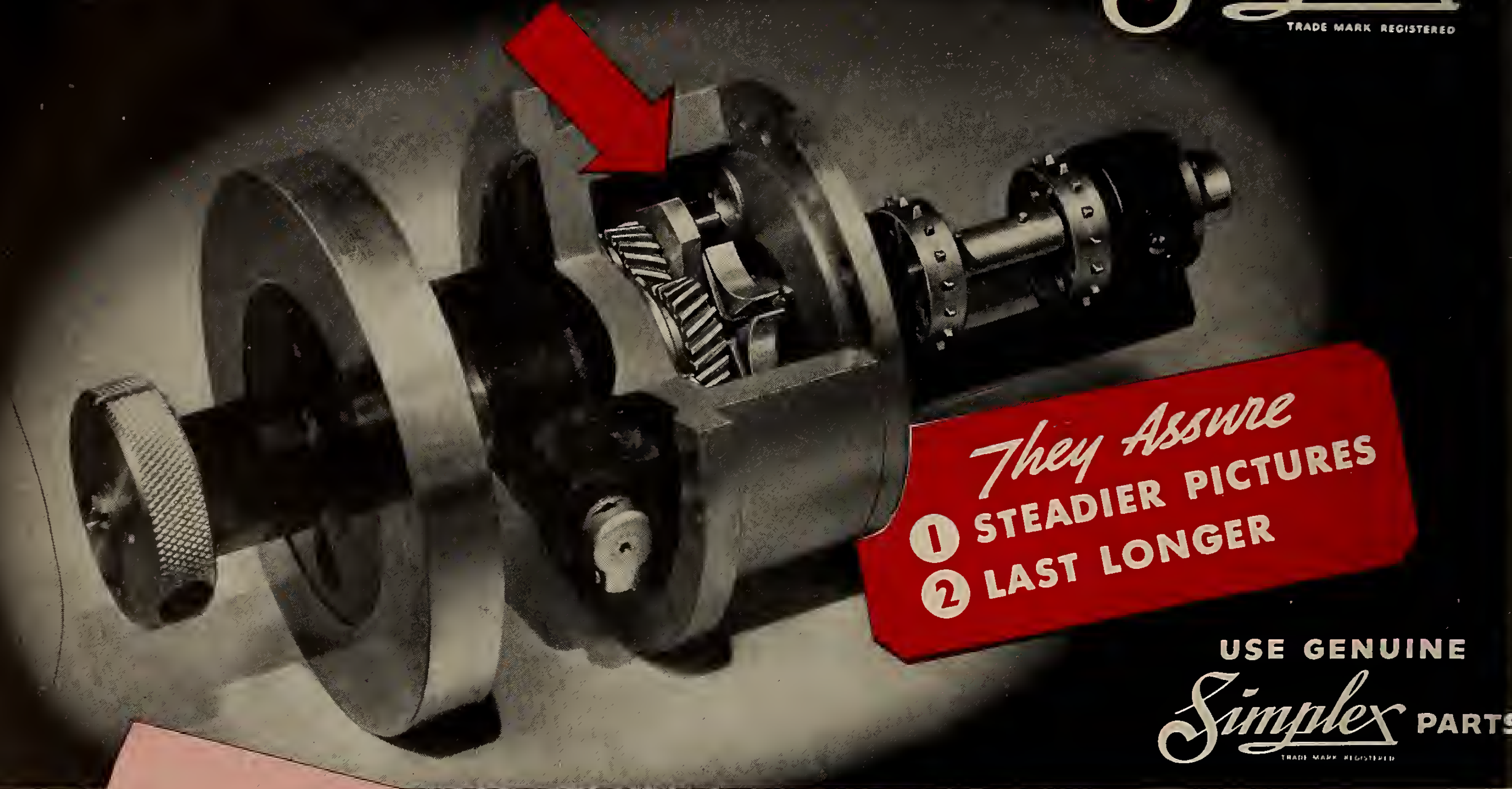
prit. A blast of air will often get you through a reel without a stop. This air may be supplied with a bellows, an electric fan, or even a newspaper folded up and moved back and forth violently. This has gotten us through on one occasion.

Liquids will cool things more rapidly, of course, but most liquids cannot be used for obvious reasons. Carbon tetrachloride is O.K. to use on electric circuits, but I doubt if I would use even that. It rots the rubber insulation, which may cause trouble at a later date, and it gives off poisonous fumes when heated. My advice is to stick to air, and if that won't do it, let 'er blow. Sometimes another fuse can be placed on top of the hot one in such a manner that the collars on the ends make contact with the collars on the hot fuse, thus relieving the hot fuse link of some of its burden and also slightly reducing the temperature by absorbing some heat. The combination of the two methods should help considerably.

Make Sure

ALL HIDDEN PARTS ARE GENUINE *Simplex*

TRADE MARK REGISTERED



PROTECT YOUR PATRONS

•

PROTECT YOUR POCKETBOOK

WHEN you have your Simplex Intermittent Movements overhauled . . . make certain that *all* parts renewed are replaced with GENUINE Simplex Parts. They are the *only* parts which will maintain the original fine projection qualities of your equipment and give you maximum service.

These Genuine Simplex Parts assure steadier pictures because they are accurate to 1/10,000 part of an inch. Such accuracy can be achieved only by our special precision manufacturing and testing equipment.

Furthermore, these Genuine Parts give longer safe service because of this extreme accuracy, the special steels used, and exclusive manufacturing methods developed through years of research. Genuine Hardened and Ground Simplex Sprockets and Star Wheels, for example, will give 5 to 6 times longer safe service than ordinary soft sprockets and case-hardened star wheels.

Protect your most valuable assets . . . good projection and satisfied patrons. Save money in the bargain . . . Insist on getting Genuine Simplex Parts EXCLUSIVELY.

INTERNATIONAL PROJECTOR CORP.
88-96 Gold Street New York, N. Y.

DON'T TAKE A CHANCE . . . USE ONLY

GENUINE *Simplex* PARTS

TRADE MARK REG'D

DISTRIBUTED BY NATIONAL THEATRE SUPPLY COMPANY

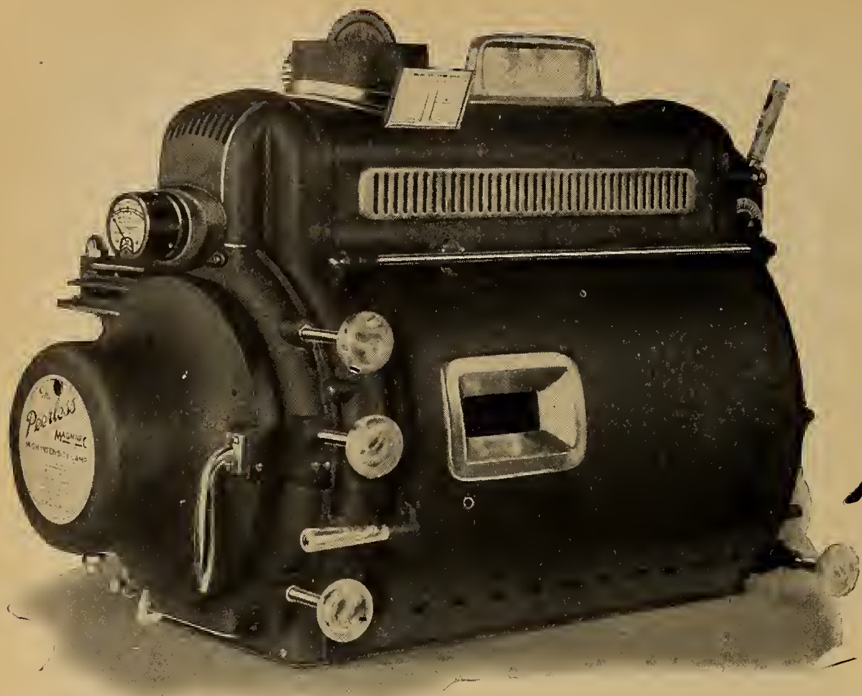
Ip

International PROJECTIONIST

SEPTEMBER 1937 Vol. 12, No. 9

25c Copy

$2 a year



Peerless

MAGNARC

TRADE-MARK REG.

HIGH-INTENSITY PROJECTION IS

ECONOMICAL!

The day of High-Intensity Projection is here. . . . It is now indispensable to even the smaller theatre. . . . Patrons' demands for it are increasing daily. . . .

High-Intensity Projection with PEERLESS MAGNARC is *not expensive.* To continue using any other type of arc lamp and the attendant high cost for the amount of light produced, simply means that you are paying out the first cost of PEERLESS MAGNARC Lamps but still are without the advantages they afford.

Remember—the initial cost is within the reach of all. . . . The PEERLESS MAGNARC produces up to three times the volume of light at no increase in current cost over Low-Amperage Reflector Arcs . . . See your nearest branch of the National Theatre Supply Company for details.

"THE FINEST ARC LAMP EVER BUILT"

SOLD BY

NATIONAL THEATRE SUPPLY COMPANY

MANUFACTURED BY

J. E. McAULEY MANUFACTURING CO.

552-554 WEST ADAMS STREET CHICAGO, ILL., U. S. A.

International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 12 SEPTEMBER 1937 *Number 9*

Published Monthly by

JAMES J. FINN PUBLISHING CORPORATION

580 FIFTH AVENUE, NEW YORK, N. Y.

Circulation Manager, RUTH ENTRACHT

SUBSCRIPTION REPRESENTATIVES

AUSTRALIA: McGills, 183 Elizabeth St., Melbourne

NEW ZEALAND: Te Aro Book Depot, Ltd., 64 Courtenay Place Wellington

ENGLAND AND DOMINIONS: Wm. Dawson & Sons, Ltd., Pilgrim St., London, E. C. 4.

YEARLY SUBSCRIPTION: United States and possessions, $2 (two years, $3); Canada and foreign countries, $2.50. Single copies, 25 cents. Changes of address should be submitted two weeks in advance of publication date to insure receipt of current issue. Entered as second-class matter February 8, 1932, at the Post Office at New York, N. Y. under the act of March 3, 1879.

MONTHLY CHAT

NATIONAL CARBON CO. will launch immediately a ten-month campaign to induce a more widespread use of "Simplified High-Intensity Projection," which is the new term selected to describe the arc heretofore referred to as Suprex. (Incidentally, N. C. will welcome a better descriptive term for this low-amperage, high-intensity arc, a term that will not conflict with higher amperage arcs.) Using trade paper advertising and direct mail, N. C. will spread the doctrine of Suprex projection among the more than 6,000 theatres in the United States which, a recent survey shows, still are using low-intensity arcs.

The material prepared by N. C. for this campaign is of high order and extremely interesting; and excerpts therefrom will be published herein from time to time. Such a campaign is a great boost for projection generally, and all projectionists should get behind it by discussing with owners and managers the material contained therein.

SO THERE are 6,000 U. S. theatres still using low-intensity arcs, are there? This disclosure proves the correctness of I. P.'s contention that the Suprex arc (excuse it, we mean Simplified High-Intensity arc) was accorded miserable merchandising. This arc exerted both a quality and a price appeal, its extra operating cost approximating that of only one admission per show. We're as much ashamed of projectionist delinquency in this direction as should be the manufacturers of their distributors.

A poor selling job all around.

INCIDENTALLY, N. C. engineers assure us that no larger Suprex carbon combination will be forthcoming soon, at least not within the next year. This information is for the benefit of those who may have been mislead by repeated assertions in this column that a larger Suprex combination was in the offing. N. C. technicians assert that Suprex-type carbons larger than the present 8 mm. combination burn away so fast that the operating expense therefor would be prohibitive. We don't know why this is so; but we'll take N. C.'s word for it, the while we hope they're wrong.

THE forthcoming S.M.P.E. Convention, to be held in N. Y. City on Oct. 11 to 14, provides an infrequent opportunity for Eastern projectionists to dig in and find out what is happening on the motion picture technical front. If you can possibly make this meeting, by all means do so.

ELSEWHERE herein is presented data on a proposal by the Academy that the present standard projection aperture be increased by 21 mils in width and 15 mils in height. Study this proposal carefully, as it may have important bearing on your present screen set-up.

INTERNATIONAL PROJECTIONIST

VOLUME XII NUMBER 9

SEPTEMBER 1937

TYPICAL TROUBLES IN MODERN SOUND REPRODUCING UNITS

By *LEROY CHADBOURNE*

IV.

THIS month's collection of troubles in current types of equipment includes one very curious case of distortion which appeared only on Sundays and holidays. Among the others is an example of poor sound confined to certain recordings, which nevertheless had to be remedied in the theatre because there was no way of influencing studio practices, and a loudspeaker outage that gave trouble for six weeks before the cause was discovered. Several minor difficulties are also listed, with remedies that should prove useful to projectionists operating similar equipments.

A theatre located in an Eastern industrial community noticed that quality from its modern 30-watt amplifier was inconstant. The blame was laid, at first, to differences in the quality of recordings. Ultimately, the staff became aware that sound was always bad on Sundays, regardless of which studio's product was used. Subsequent checks showed that the same condition existed on holidays. Week-day sound was very good.

Since poor line voltage regulation seemed the only possible cause, complaint was made to the power company, and a recording voltmeter (see I. P. for December, 1932, page 8), was installed temporarily without charge to the theatre. Records taken by this meter over a period of three weeks, including one holiday, correlated the poor sound quality with a consistent increase in line voltage, to the extent of about 9 volts, on the holiday and on all three Sundays. However, the power company stated that the same condition had probably existed for many years; and the sound system previously installed in the theatre had given the same results on Sundays as on any other day.

Trouble on Holidays Only

The former amplifier had been a strictly Class A job, which distorted slightly under extreme overload, but was strictly limited in power. The new amplifier followed modern practice in that it was of the Class AB type capable of enormous increase in volume when the recording called for it, but at the penalty of some distortion. Extremely high volume tends to mask the presence of distortion, and such amplifiers are used in some of the most expensive and elaborate of modern systems.

What happened in this theatre was that the increase of 9 line volts, experienced on Sundays, was stepped up to an increase of some 60 volts by the action of the power transformer, and was causing the amplifier to function as a Class B unit even when volume was low.

The remedy was found in the purchase of a simple and very inexpensive step-down transformer, and a double-pole, double-throw switch. The transformer manufacturer was advised of the degree of voltage regulation desired and the *wattage requirement* of the sound system. This second item of information was very important, since it insured that the secondary of the transformer would be wound of wire heavy enough to carry the current passing through it, in the unusual application for which this transformer was intended.

The transformer and switch were assembled and wired as shown in Fig. 1. To conform with underwriters' requirements, the assembly was mounted in an unused cut-out box that still remained on

the projection room wall, a relic of the earlier and more elaborate installation. With the set-up shown in Fig. 1 in opera-

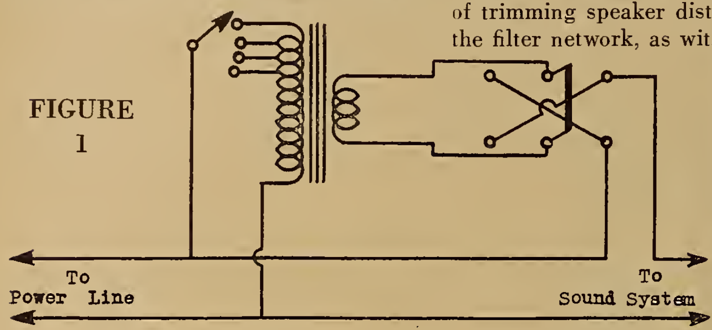


FIGURE 1

tion, good sound was obtained on Sundays as readily as on any other day.

It will be noted that the transformer secondary, in Fig. 1, is in series with the power supply to the sound system. Any voltage generated in that secondary by the action of the transformer will, therefore, either aid or oppose the line voltage, and can be made to do either by using the double-pole, double-throw switch to reverse its phase relationship with the line. The tapped primary permits a change in the extent of voltage compensation. The arrangement is very similar to, but simpler than, the one diagrammed and described on page 7 of I. P. for May 1935.

To complete Fig. 1 for practical purposes an a.c. voltmeter should have been connected across the arrowheads leading to the sound system, to inform the projectionist what voltage he was actually putting into his equipment. The meter was omitted for reasons of economy, and the amplifier plate current meter used instead in a somewhat unusual way. The plate current meter will indicate proper operation, provided both the amplifier and its tubes are in perfect condition. But if the tubes become weak or gassy or otherwise defective the plate current reading will change, of course. With this in mind a new and perfect set of tubes was installed on a weekday, and the meter reading noted. These perfect tubes were then set aside for emergency and for use as standards of comparison. On Sundays and holidays the apparatus of Fig. 1 is adjusted to give the same plate reading as always, but if there is any doubt about the condition of the tubes in use, the standard set is installed temporarily to afford a check-up.

Difficulty With Some Recordings

A newly installed sound system, capable of extended frequency reproduction, gave inconsistent results in a small theatre. With some recordings sound was extremely satisfactory, but other recordings were "barrelly" or "tubby" through the presence of too much bass. A dual speaker system was not used; the smallness of the house and the dictates of economy indicated the choice of a single speaker set-up, consisting of dynamic units capable of covering the range from 50-8,000 cycles, and mounted on flat baffles. Hence there was no possibility of trimming speaker distribution through the filter network, as with a dual system. The amplifier was equipped with a tone control, which was set for full high-frequency response, but there still was too much bass in some pictures.

Several methods of modifying the amplifier response were discussed, but the equipment was still under guarantee which would have been voided by any changes in the amplifier wiring. Therefore, it was decided to trim the baffles. Two inches were cut away from all four sides of each baffle board. This effected some improvement, but, as expected, not enough. Another two inches, and, finally, one inch, were cut from all four sides of both baffles.

Thereafter the products of studios that had to much bass for this theatre sounded very good indeed; but pictures that formerly sounded good now did not have bass enough. This was adjusted by bringing down the amplifier tone control from its extreme high-frequency position whenever such pictures were played. Occasional re-setting of the tone control is all that is necessary now to provide sound in this theatre with any American product.

Inefficient Sound Distribution

A modern sound system recently installed used two high-frequency, multicellular horns, each driven by a single high-frequency speaker; and two low-frequency, multi-cellular horns. The latter were operated by two dynamic units each, making a total of six speakers working through four horns.

The sound checker and the manager noticed that there was one portion of the auditorium where sound didn't seem quite right, a deficiency which they attributed to their imaginations. Eventually they decided that the location in question was experiencing definite trouble when the house was crowded, and at other times, sound that was not quite what it should be. Investigation showed that one of the two dynamic speakers in one of the low-frequency baffles had burned out, and apparently had been out for about six weeks.

After replacement of the defective unit, a check-up panel was built and installed backstage. The new sound system, like many of the more recent models, included no provision for individual check upon the speakers. Hence the panel of Fig. 2 had to be built to order for the theatre. The proper place for that panel was, of course, the projection room; but individual speaker lines did not run to the projection room, they branched from common feeders in a box behind the screen. The panel of Fig. 2 was therefore located alongside that box, and a test routine was worked out in cooperation with the stage crew. If there had been no stage crew, separate speaker lines would have been run to the projection room, or one of the projection crew would have had to go backstage to complete each morning's tests.

Figure 2 does not show the whole test panel but only one section of it. There are six identical sections, one for each speaker unit. The single section drawn in Fig. 2 includes the speaker, which is seen at the right. It consists of a triangle (the cone), with a voice coil wound around its apex, and a field magnet winding to the left of the coil. Two test jacks are provided for each speaker, one to test the voice coil and one to check the field winding.

These jacks are identical in construction. In normal operation the top prong is in electrical contact with the prong just below it, and the bottom prong is in contact with the one just above it. Looking at the lower jack, it will be seen that

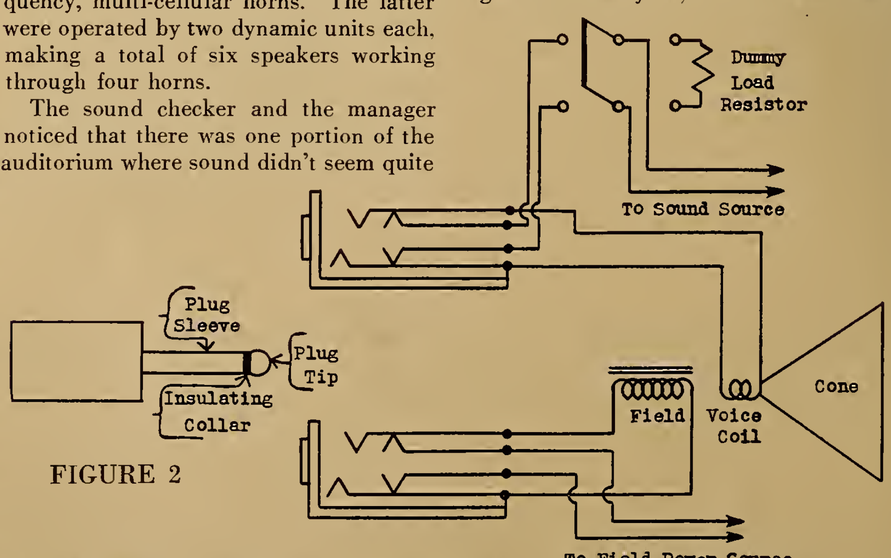


FIGURE 2

these prong contacts provide direct continuity between the field winding and the source of field power.

However, when the plug is inserted in

the jack, the top prong is lifted upward and the bottom prong is forced downward. The normal contacts with the two center prongs are thus broken; the field is no longer in contact with its power source, but only with the plug; the left-hand side of the field with the tip of the plug, and the right-hand side with the plug sleeve. The plug connects with an ohmmeter, not shown in the drawing, and when it is inserted in the jack, the meter tests the field winding for open or short-circuit.

The arrangements of the upper jack, which connects to the speaker voice coil, are identical; when the plug is inserted in that jack, the ohmmeter checks the voice coil. However, the wiring of this upper jack is slightly complicated by the presence of the double-pole, double-throw switch and its dummy load resistor. That switch is used for normal tests, the jacks being resorted to only when trouble is indicated.

The morning routine in this theatre calls for telephone contact between the stage and the projection crews. When both are ready, a few hundred feet of test reel are run. The stage crew throws all the switches of the test panel to the dummy load position; consequently no sound is heard. But the dummy resistors preserve impedance match and constitute a proper load across the amplifier output. The switches are then thrown to left, or operating, position one at a time, so that each speaker unit can be heard singly. Any defect uncovered in this way is then run down by means of the plug and meter, during the show if necessary.

All of the parts used in this test panel are standard equipment. The jacks can be obtained from any electrical, telephone or radio supply house, at prices running from twenty cents to, perhaps, two dollars apiece, depending upon quality. The dummy load resistor should, of course, be of the same value as the voice coil impedance. If the latter is not known, the d.c. resistance of the voice coil can be read with the ohmmeter, and multiplied by $1\frac{1}{2}$ to give the a.c. speech impedance with sufficient accuracy.

Fan Protects Power Transformer

An odd an somewhat haywire repair is now in use in a theatre that has a fairly modern sound equipment, but expects to replace it in the near future with one of still more recent design. This theatre burned out an amplifier power transformer several times in the course of a year. The manufacturer of the equipment advised that this condition was highly unusual. A representative was sent, at no cost to the theatre, to check conditions. He found that the amplifier was located in a hot corner, with no direct ventilation, and that the power transformer was overheating in consequence. The only suggestion was to either move the amplifier or buy a special power transformer which would be wound to order, at a rather high price, but would be guaranteed to stand up under the conditions.

However, the theatre was then negotiating for an entirely new system of different make and was unwilling to take much trouble with the old one. The projection chief on his own initiative bought the smallest and cheapest electric fan he could find. This was mounted so as to play directly on the transformer through the amplifier's grill cover. No trouble has been encountered since, and it appears certain that the standard transformer will hold out until the present equipment is replaced.

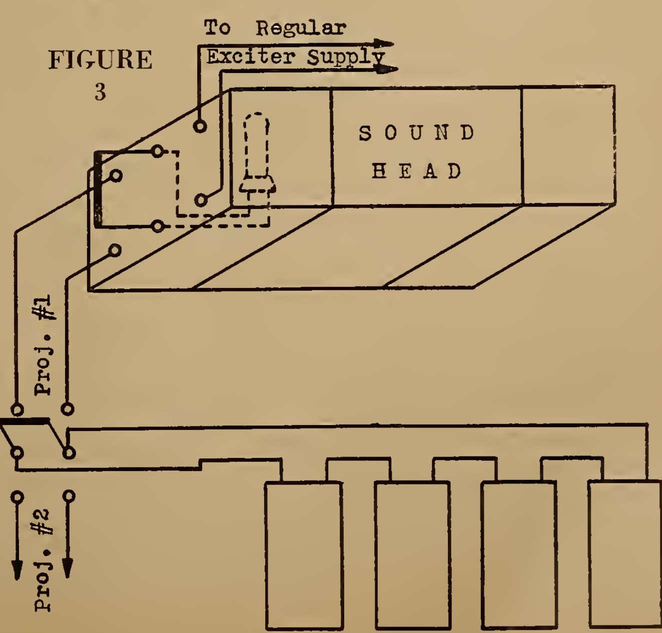
Practical Focussing Accessories

A theatre that is troubled with erratic line voltage has a system in which sound change-over is worked by switching the exciter current. A fairly large number of such installations, dating from about 1935, are now in use. Only one exciter can be lit at a time, consequently there is no way of focussing those lamps during the show. A pre-focussed lamp, mounted in a clip socket for instant insertion, is kept near each projector.

A batch of decidedly poor lamps, plus probable excess of exciter current arising out of unstable line conditions, resulted in three burn-outs in a single day, two of which were on the same projector. Since a second pre-focussed lamp was not available, the only possible procedure was to change the reel to the other machine, and then install a new lamp and guess at the focus. The guess, naturally, was not too accurate, sound after the change-over was extremely poor, and adjustments had to be made with the audience listening in.

The obvious remedy of buying additional clip sockets and keeping more than one lamp ready for one pre-focussed each machine, failed to satisfy the projectionist in charge. He thought that the arrangement, although approved by one of the largest makers of sound equipment, was unreliable and unsatisfactory, and determined to add provisions for focussing his own exciters at any time. Four dry cells and three double-pole, double-throw switches were all that were needed.

FIGURE 3



The arrangement is sketched in Fig. 3. Only one sound head is drawn in, but the other is equipped and wired in exactly the same way. The lower switch shown in Fig. 3 permits the same dry cells to serve either projector. The switches mounted at the rear of the sound heads are normally kept in the "down" position to provide exciter supply from the regular source, which is the power pack of the amplifier, and are thrown to the "up" position only for focussing during the show.

An Important Precaution

The cells are standard bell-ringing size and four in series, even when not quite new, give ample light for focussing purposes. They are never used for more than a minute or two at a time, and that only seldom, consequently they last a long while despite the heavy drain of the lamps.

One important precaution must be observed in using this arrangement. The photocells of both projectors are *always* "on"—change-over being effected, as said, by switching the exciter current. Hence the normal disturbances of focussing will be heard by the audience as an unpleasant background noise, unless the photocell involved is carefully covered or shielded before the sound head switch of Fig. 3 is thrown up and kept shielded until after the adjustments are completed and the switch has been thrown down again.

Neon Bulb Checks P.E.C. Voltage

Poor sound in a small theatre was traced to low photocell voltage, which was derived from the amplifier. It was adjustable by means of two slotted boltheads which were, theoretically, so built that they could be locked in position when the proper setting was obtained.

(Continued on page 29)

Increase the Projector Aperture—Academy

Proposed 0.846 x 0.615 Inch Size Counters S.M.P.E. Request For Photographed Area Tolerance; Great Expense, Trouble for Negligible Gain Seen; Technical and Economic Aspects of Proposal Considered.

By *JAMES J. FINN*

THE Academy of M. P. Arts & Sciences proposes an increase in size of the present Standard Projector Aperture, from 0.600 x 0.825 inch to 0.615 x 0.846 inch. Simply expressed, this increase of 21 mils in width and 15 mils in height of the present standard aperture would mean a new aperture and remasking, at least, for theatres throughout the world—a matter not to be taken lightly and one that merits careful consideration of all the factors involved.

The Academy suggestion is regarded as a counter-proposal to the recent recommendation of the Projection Practice Committee of the Society of Motion Picture Engineers for a 10-mil tolerance in width and in height of the photographed area. This tolerance was requested because of complaints that in many theatres, and particularly where projection angles normal or above prevailed, the heads or feet, or both, of characters and some portions of titles were being cut off the screen image by the projector aperture. So widespread was this occurrence that the Committee included in its report to the Spring Convention of the Society, held in Hollywood, the following recommendation:

"Experience has shown that on a 9 by 12 foot screen at an angle of projection of approximately 15 degrees, a 1-inch masking . . . has proved sufficient to assure proper projection. This 1-inch masking represents a decrease of 0.005 inch approximately on each side of the projector aperture, or an aperture 0.815 inch wide by 0.590 inch high, 0.738 ± 0.002 inch from center line to guided edge.

"The Committee recommends that . . . cameramen and studio laboratories provide their camera-focusing devices and viewfinders with a working ground-glass having a rectangle of the conventional black line corresponding to the dimensions 0.815 by 0.590 inch, as an aid to the cameraman in composing his picture (Fig. 1).

"The Committee also recommends that a minimum masking . . . be established. For example, on a 9 by 12 foot screen the masking should not overlap the projected picture more than 1 inch on each side; for smaller or larger screens this masking . . . should be of the same approximate ratio."

The Committee report was read before and approved by the Society Convention, and it was subsequently published in the *Journal* for July, 1937, p. 39. Its content caused Hollywood photographic technicians to prick up their ears. Conferences ensued, at least one of which was attended by a Society representative, who was told that something undoubtedly would be done about the recommendation, advance advice on the nature of which would be forthcoming.

Such advance notice apparently was not forthcoming; and the Hollywood reaction to the S.M.P.E. recommendation was not made known until publication on Sept. 20 of the proposal by the Academy Research Council that *the projector aperture be enlarged* to 0.615 x 0.846 inch.

The Academy proposal, of course, is not related even remotely to the S.M.P.E. recommendation, as is evidenced by the drawing accompanying the Academy proposal (Fig. 2), which is bare of any indication as to the limits within which the cameraman will compose his picture and thus ignores completely the request of projectionists for a slight tolerance in the photographed area.

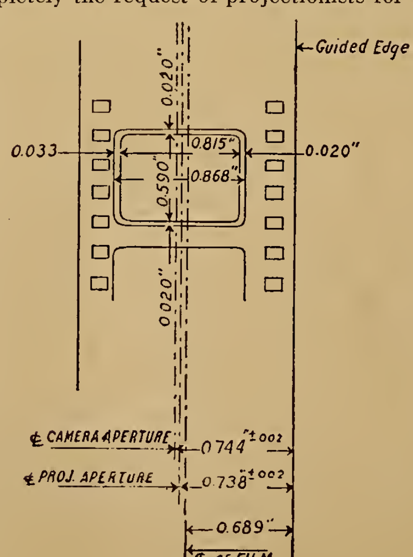


FIGURE 1
S.M.P.E. recommendation for area of photographed action

The Academy proposal has two important aspects. the technical and the economic, which will be considered in that order.

If motion pictures were accorded level projection onto, say, a white space of the exact dimensions required, masking would not be a problem. But an overwhelming majority of theatres have angle projection (about 15 degrees is the average), and a condition popularly known as the "keystone effect" becomes increasingly obvious as the projection angle rises above 10 or 12 degrees. Naturally, every theatre likes to show pictures with parallel sight lines, or as near as possible approximating the conditions under which they are photographed. With a 20-degree projection angle, for example, this "keystone effect" compels the sacrifice of 6 or 8 inches of screen area for masking.

A case in point is the recent two-a-day showing of "Souls at Sea" in N. Y. City at the Globe Theatre. which has a 25-degree projection angle. (This is admittedly a steep angle, but the example is applicable in varying degree to even those theatres having what are considered normal projection angles.) Not only were the heads and feet of characters in this picture cut off, but vital action at the sides was lost; also, credit lines on titles were cut off on the sides.

The difficulty was overcome, true, but only by smart projection sense and no little hard work. Much time was spent filing special apertures almost to the edge of the sprocket holes and the sound track—in fact, filed to more than the camera limit! How many theatres, even if favored with smart projection sense, have the time or the facilities or the bankroll to sponsor such activity?

Because of numerous complaints anent similar occurrences, the Projection Practice Committee of the S.M.P.E. decided to do something about the matter. It suggested the aforementioned simple method whereby all vital action should be maintained *within* the projector aperture. It asked for only 5 mils top and bottom and on each side (a total of 10 mils each way), as a camera tolerance. This tolerance, if granted, would mean the loss of only 3½ inches in width on a 20-foot screen. The simplicity, the reasonableness and the correctness of this request is best attested to by the fact that the Academy does not now propose increasing the camera aperture.

Photographed Area Limits?

The Academy answer to all this is to suggest that the size of the projector aperture be increased. But the most vital technical question still remains un-

NOW . . . A NECESSITY IN EVEN THE SMALLEST HOUSE

SIMPLIFIED *High Intensity* PROJECTION

But any theatre can afford it!

Simplified High-Intensity Projection affords real economy, giving two to three times as much light as your low-intensity at a greatly reduced cost per unit of light.

Only High-Intensity Projection provides the white light essential to satisfactory projection of the new color pictures, which are being shot under lights having the same characteristics.

THE STRONG MOGUL

—is the lamp that delivers this tremendously increased volume of light without a corresponding increase in operating costs—steady, brilliant light, distributed uniformly over the complete screen area, projecting a picture full of depth and definition which possesses a sparkling, daylight effect.

An Invitation!

Write for interesting catalog and name of your nearest Independent Theatre Equipment Dealer. He will, without obligation, arrange to demonstrate the Strong lamp in your theatre.

The STRONG ELECTRIC Corp.

2501 LAGRANGE ST. TOLEDO, OHIO, U. S. A.

EXPORT OFFICES:

ROOM 2002, 220 W. 42nd ST., NEW YORK, N. Y.

answered: Whether the present or the proposed new aperture be effective, within what limits will the cameramen compose their pictures? and will the tolerance requested by projectionists in order to include all vital action on the screen be observed? This qustion is wholly detached from consideration of whether the proposed new aperture is desirable on the score of other technical or economic grounds.

It has been intimated that the new aperture will have no effect whatsoever on current theatre practice, that theatres can either take it or leave it, with the enlarged photographic area being projected onto the masking, without any untoward consequences. This assumption is sheer nonsense, because the net result of such procedure would be to aggravate rather than alleviate the very condition which projectionists now seek to correct. This fact is so obvious as to require no extended comment here.

Acceptance of the Academy proposal for a larger projector aperture will mean that every theatre will have to install new apertures and also remask their screens. This requirement presents no insurmountable difficulty, but it gives rise to another problem that will induce plenty of trouble. Many screens now in use extend flush to the edge of the available space. A new and larger projector aperture might well necessitate the purchase of not only new screens but of frames as well. How much thought has been given to this angle by the sponsors of a new aperture?

Anyhow, just what will the introduction of a larger projector aperture mean to the dramatic content of the motion picture, to its generally increased effectiveness as a medium of expression, and to the betterment of the exhibitors status in particular and that of the industry in general?

Practical Benefits Considered

The writer finds that the utilization of the proposed new aperture will add 6 1/10 inches to the width and 4½ inches to the height of a 20-foot screen. He finds, further, that, expressed in terms of percentage, the larger aperture would result in 5.1% more delineation on the screen—that is, 5.1% more detail or story-telling ability *physically*, but not in terms of dramatic content.

Now, it is true that ever since sound pictures were introduced every serious-minded technician has bemoaned the loss of photographed area and has considered carefully every means possible for regaining this loss. Along comes the Academy with a proposal to restore 6 1/10 and 4½ inches to the width and height, respectively, of the screen. It certainly would be nice to have this extra area; but the pressing question is: Is this comparatively small additional area worth all the trouble and expense involved?

The cost of changing-over apertures varies in different sections of America and throughout the world. New apertures could be had for 60 cents each, but the cost of remasking is something else again. Remasking in a so-called de luxe theatre in a large city might easily mean an expense of $125, mostly for labor; with this cost being scaled down proportionately in the smaller cities and towns. In addition, there remains the threat of further expense to those theatres which would require new screens and frames, as previously explained.

Experience proves that the general introduction of a new aperture extends over a considerable period of time, during which the projection process would be one beautiful mess.

This writer is certainly in favor of regaining the photographed area that was sacrificed to the requirements of sound pictures. He would have no objections to the proposed new aperture standard, provided assurances of correct positioning of the hairline on the camera groundglass were forthcoming. Also, if the larger aperture were adopted, he would be inclined to ask for a greater tolerance than that requested by the S.M.P.E. (5 mils on each side and on top and bottom) and would ask for 7½ mils on each side in order to play perfectly safe.

In answer to the question posed previously as to whether the new aperture is worth all the trouble and expense involved, this writer, mindful of the comparatively small benefits to be derived in terms of a negligible increase in dramatic value of the photographed area, would reply with an emphatic "No."

But whatever happens to this proposal—whether the present standard aperture prevails or the proposed standard be adopted—one thing is certain: Immediate provision should be made, by suitable marking in the camera ground-glass, to prevent any loss during projection of the vital content of the photographed area; and, if any change in aperture size is made, this provision should be carried over as an integral part of the standard.

The Academy proposal of a new aperture standard in no way affects the validity of the S.M.P.E. recommendation relative to current, or even future, studio or theatre aperture practice requisites.

Exchange Organizing To Cost Industry Two Millions

The unionization of exchange employes may cost the industry an additional $1,500,000 to $2,500,000 annually, according to estimates made by distribution executives.

The wide variation in the cost estimates results from the fact that wage scales of individual companies prior to the organizing movement differed considerably. Thus the new union scales represent greater increases in costs for some companies than for others, with the result that no standard average of increase covering all distribution companies can be determined. Several distributors were already paying the present minimum wage scales prior to the organizing movement, others were paying approximately the present minimums, while still others were appreciably below the new scales.

Another factor contributing to the uncertainty of the increased distribution cost is that the scales being placed in effect differ according to the location of exchange centers.

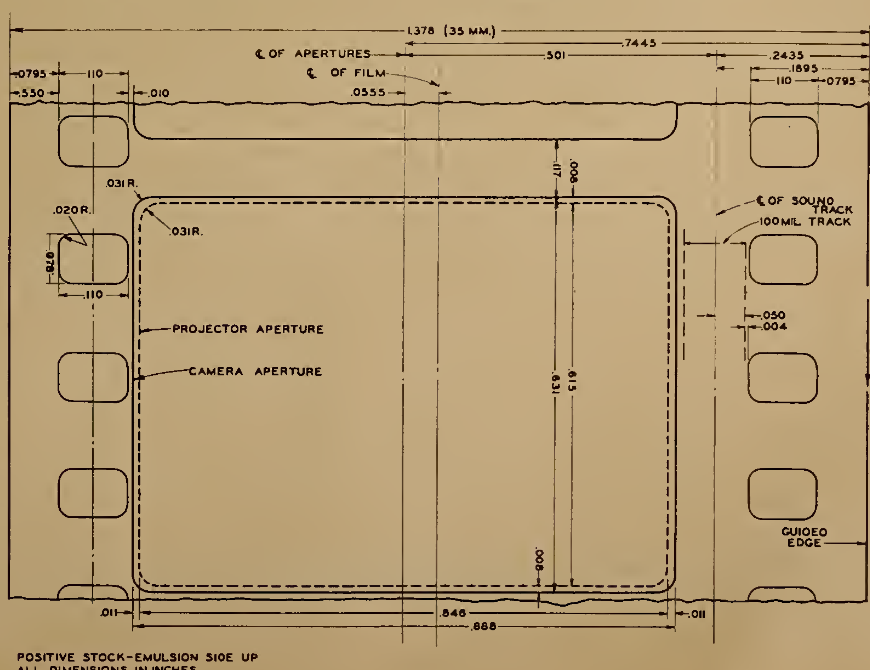


FIGURE 2. *Proposed revised standard projector aperture*

CANADIAN COMMISSION KILLS LICENSED 2-MEN SHIFT, APPROVES APPRENTICES

CANADIAN projectionists were dealt a knockout blow, and a dangerous precedent that ultimately may affect all units of the organized craft in America was set, when the Commissioner appointed by the British Columbia Provincial Government to inquire into projection manpower and safety requisites rendered a report which in effect sweeps away the gains made by B. C. craftsmen during the past 25 years. The Commissioner's findings, from which there is no appeal, were submitted upon completion of the hearings, the first portion of which was reported in I. P. for July, p. 21.

B. C. projectionists will feel the loss of this bitterly contested battle almost immediately—that is, on Jan. 1 next—and there can be no doubt that Canadian theatre interests, who engineered the proceedings, will lose no time in reaping the fruits of their victory by extending the plan throughout Canada. The ultimate effect of this breakdown of conditions upon American unit is too obvious to need recounting here.

The Commissioner's report is appended hereto. Preceding a summary of the report is a brief resume of the testimony adduced at the second portion of the hearing, which data are given here through the courtesy of Secretary E. J. Williams of L. U. 348, Vancouver, B. C.

The owners produced a succession of manager witnesses, only one or two of whom had had any practical projection experience, thus the testimony was opinion only. An ex-Local member, now a manager, tried desperately to discredit Union witnesses, but under cross-examination he could not substantiate his claims. A sworn statement of the number of fires occurring in the Province of Manitoba, obtained from the Fire Marshall, revealed 23 fires there from 1927 to 1937.

Program Revision Requirements

Visits to theatres revealed that the build-up and revision of the usual double-feature show, with shorts and trailers, prior to running required from 1½ to 2 hours. The breakdown of a show runs to similar length, except that it extends throughout the last screening. Thus, in suburban theatres having three changes weekly the crew is either building-up or breaking-down a show every night. The average suburban theatre in B. C. has automatic curtain controls, stereo or effect machines of some kind, and remote stage lighting—all of which is controlled from the projection room.

The Commissioner journeyed to Seattle to witness the one-man shift operation there. He visited two downtown theatres, two Class A suburban theatres, and one dump downtown. It was noted that while the shows were put on smoothly enough the duties incident upon the one man present made it impossible for him to be at the side of his projector or give any attention to the screen image. Seattle men work 21 hours weekly, three days one week and four the next in six-hour shifts.

A radio repair man who had worked on several sound installations testified that with three hours instruction he could thread-up the projection, trim and strike an arc, and revise film. Questioning developed the fact that he did not consider himself a qualified projectionist within the usual meaning of the term. A 15-year old boy, an exhibitor's son, next testified that with three and one-half hours instruction he could do equally as well as the preceding witness. A schoolmate of his stated that his chum had confided to him 18 months previous that he could operate a projector, or at the age of thirteen and one-half.

F. Smith, a member of L. U. 348, described a fire occurring in his theatre within the preceding week, necessitating his removal to a hospital for treatment of severe burns on his face and hands. The film broke and piled up below the sound sprocket, Smith becoming aware of it when the film ran over the head amplifier, picture and sound being o. k. After shutting down, he opened the projector head and sound compartment doors, upon which the film poured out and immediately burst into flames, evidently having contacted the cooling plate. About 200 feet of film burned.

Aperture Temperature Reference

The exhibitors' attorney then tried to infer that with a low-intensity lamp pulling 30 amperes the aperture heat would approximate only 800 degrees, which temperature would be reduced one-half through use of a rear-shutter. This reduced temperature, he asserted, was so close to the ignition point of film, 320° F., that ignition would be very difficult. He neglected to consider the fact that the cooling plate, being exposed to high temperatures, would retain its heat for a considerable time.

A lady who had played piano in theatres before sound pictures gave a graphic description of audience reaction when the image of burning film was projected on the screen. Her testimony was highly effective.

The hearing closed with a demonstration of the Pyrene Automatic Fire Extinguisher, which employs a carbon-dioxide cylinder. Equipment used was a Super-Simplex mechanism, RCA sound, and Peerless 100-amp. lamps. Representatives of both sides, the Commissioner, and fire authorities were present. About 150 feet of film was placed in the top magazine and the projector threaded with the sprocket holes cut through below the top sprocket.

'Automatic' Extinguisher Unreliable

The projector was started with the dowser open. This was repeated several times, with a frame burning each time, but the extinguisher did not work. The test was run again with the film gate open and a small amount of film piled into the head. The projector was started, the film ignited, and this time the extinguisher worked—but it did not prevent complete combustion of the film in the head. The fire did not go through the magazine rollers into the upper magazine where there remained some film on the reel. The projector was cleaned, a new cylinder put in, and another test run with the film gate open. This time the extinguisher worked and only one or two frames were burned.

When the fuse burned through and the extinguisher went into operation a loud hissing or rushing sound was heard, like a locomotive blowing off steam, accompanied by dense volumes of smoke and gas which smelled strongly of burning celluloid and chemical. Projectionist representatives present opined that the device might have some value, but that it would not extinguish a big pile-up and does not seem to operate on a "pop" or when a single frame of film is burned. There is no guarantee that it will operate when most needed, nor does it prevent the appearance of the image of burning film on the screen. Moreover, the only way a cylinder of CO^2 can be tested is by weigh-

ing it continually. The B. C. Fire Marshal has not yet approved it.

Charge Union 'Job Monopoly'

During the summations the exhibitors' attorney took the position that the Union's evidence and exhibits had been grossly exaggerated and that "the close combination of projectionists in this province (B. C.) is the nearest thing to complete monopoly that I have ever seen in any form of employment. The lawyers think they do very well, but they are the rankest amateurs compared with this institution (the Local Union)." He admitted certain things such as the need for public safety, the inflammability of film, its danger when not handled properly, the quick spread of fire, and room safety requirements; but he asserted none of the projection men have made out a clear case for shifts of two licensed men.

The Union attorney stated that the enquiry was to determine safety conditions in theatres, and was not a fight between Union and exhibitors. The latter's only interest, he said, was to save one salary. He pointed out that every recognized expert in the business had testified to the necessity for two qualified projectionists; whereas the exhibitors had not produced even one witness who qualified as an expert to refute this testimony. Exhibitor witnesses were almost exclusively owners or managers who were financially interested in theatres. As for the so-called "automatic" fire extinguishers, said the counsel, if they were so efficient, why had not the exhibitors installed them long ago? He reviewed the evidence of film fire fatalities and asked the Commissioner to bring in a report that would safeguard theatre patrons.

As stated previously, the Commissioner brought in a report which sustained the contentions of the theatre owners on almost every point. The immediate net result of this ruling will be to wipe out the earning capacity of about one-half the projectionists holding first-class licenses in B. C., with similar moves likely to extend to other parts of Canada and, ultimately, to the United States. Although there is no appeal from the ruling of such special commissions, L. U. 348 will be represented at a meeting of the B. C. Provincial Cabinet on Oct. 4 to review the findings.

Should the findings be allowed to stand, L. U. 348 will probably have to make a deal with the theatre owners on the basis of total room cost, at a figure much less than now, with the job of allocating the wages being up to the Union. One chain theatre group, Famous Players Canadian Corp., has already proposed this procedure.

The Commissioner's report is published here in part as a lesson and a warning to all units of the craft:

Commission Report Kills Licensed Shifts

By commission under the Public Inquiries Act I was appointed a Commissioner to inquire into the following questions:

(*a*). Whether it is contrary to the public interest to allow less than two licensed projectionists to operate a Kinematograph in a projection room containing more than one Kinematograph under the conditions prescribed in Regulation Number 31 referred to in the said Commission;

(*b*). Whether it is in the public interest to have more than one class of projectionists in addition to apprentice projectionists licensed under the said Act and Regulations;

(*c*). Whether it is in the public interest to allow a Kinematograph to be operated in a moving picture theatre that has no rewind room; and

(*d*). Into all matters incidental to the matters aforesaid.

Regulation "31" reads as follows:

"In all moving-picture theatres equipped with two or more kinematographs there shall be at all times in the projection-room when the theatre is open to the public two licensed projectionists; provided, however, that if each of the kinematographs is equipped with an approved automatic fire-extinguisher, then one licensed projectionist together with one licensed apprentice projectionist shall be sufficient; and provided, further, that the last-mentioned proviso shall not affect any contract existing at the time these regulations come into force between the owner or operator of any moving-picture theatre and a licensed projectionist or union of projectionists whereby the owner or operator is bound to employ two or more licensed projectionists in the projection-room; and that in any event the said last-mentioned proviso shall not take effect until the first day of January 1938."

It is to this first question, *a* aforestated, that most of the evidence was directed. In addition, I had the advantage of visiting a number of theatres in Vancouver where two projectionists are employed on a shift. I was thus able to obtain first-hand information on projection room procedure and operation. In addition, I visited a number of theatres in the city of Seattle, where one projectionist is employed; and I also witnessed a demonstration of the Pyrene Automatic Fire Extinguisher.

Regulations Conform To Standards

It is generally admitted that the motion picture regulations in British Columbia are up to standard and would appear to be adequate. The report of the National Research Council (Canada), made in 1933, says with reference to these regulations that the size of the projection rooms conform almost completely with the largest dimensions recommended by the Society of Motion Picture Engineers, and that the fire resistance of the rooms and the regulations regarding port holes and shutters agree closely with the best recommended practice. The projectors, too, would seem to be well up to standard and equipped with the usual safety appliances.

With silent pictures only one projectionist was employed on a shift. He operated the two projection machines, alternating from one to the other, attended to the revision and rewinding of the film, the threading-up, and other necessary duties.

With the advent of sound pictures, the sound was reproduced by means of a synchronized disc record, which meant a considerable increase in manual labor, and two licensed projectionists were employed. Subsequently, the regulations were amended to provide for the employment of two licensed projectionists where two projectors were used. These regulations were amended in 1936, as provided by Regulation "31" above.

When the sound track was placed on the film, the operator (exhibitors) felt that the necessity that had theretofore existed for two qualified projectionists in the projection room no longer existed, and representations were made for a change in the regulations. The owners contended that with two projectors it is unnecessary from the standpoint of public safety to have two licensed projectionists. On the other hand, the projectionists contend that in the interests of public safety two licensed projectionists are necessary at all times. That the duties of the projectionists after the sound was placed on the film were lessened, is apparent from the evidence before me.

Sound Film Lessened Work

This is dealt with, too, in the report of the National Research Council as follows:

"The trend is undoubtedly towards insuring a more and more automatic routine with the discard of sound on disc equipment and the automatic maintenance of the appropriate average sound level the burden placed upon the projectionist, due to the added sound, has been rendered much smaller than it was a few years ago.

"In the early days of pictures combined with sound, disc records were used with large percentage of the theatres. This method has now been discarded by all companies and the sound is reproduced from the film itself . . . These mechanical improvements have reduced the amount of work a projectionist has to do and it is probable that further steps along this direction will be made."

The evidence before me shows, too, that the placing of sound on the film has not increased the fire hazard. The equipment used in the ordinary projection room consists of two projection machines, a light effect machine and a stereopticon machine.

It is common ground that the film is highly inflammable and ignites at a temperature of approximately 320 F. and with the most modern equipment will be ignited by the heat from the

(*Continued on page 29*)

A 'CATCH-ALL' TEST FOR PROJECTION ELECTRICAL AND OPTICAL EQUIPMENT

By *PHILIP MARTIN, JR.*

PROJECTIONIST, NATIONAL ARCHIVES, WASHINGTON, D. C.

The significance of this and other similar articles appearing in these columns with increasing frequency is the emphasis placed on the acute need of the practical projectionist for suitable test equipment, whether for routine inspection purposes or for emergency checking when trouble develops. That I. P. has long recognized this need is reflected in the generous space allotted to articles of this character.—Ed.

A "CATCH-ALL" test for the electrical and optical equipment connected with projection sound equipment may be simply and easily made by using a suitable output meter and a frequency reel. By placing the meter in parallel with the output circuit of the main amplifier while it is carrying a full load (both stage and monitor speakers), one can check the response of each reproducer over a range of from 50 to 10,000 cycles.

If the test reel has been recorded for the purpose of making adjustments in the reproducer, or has what is commonly known as a buzz track, scanning too close to the sprocket holes or to the picture can be detected and reduced to a minimum more efficiently by adjusting by meter rather than by trusting to one's hearing, which is confused by the hum of the motor, the noise of the gear chain, and other normal room sounds.

Taking and listing readings over a range of from 50 to 10,000 cycles [Fig. 1] gives an excellent picture of how each individual reproducer is responding. If at any time, a db. loss greater than one step on the fader (usually calibrated in 3 db. steps) is noticed, the projectionist can be sure that his change-overs will be heralded by a blaring or a fading of the sound. Once the projectionist knows exactly the difference in db. between his reproducers, he can determine whether the trouble is caused by a blackened exciter, poor scanning, or by a gradually weakening photo-cell.

One Reading as a Standard

If a reading is made when the system is new or known to be in perfect condition, it can be used as a standard for any other tests of the same character made on the same equipment. If, upon comparison of the two readings, any deviation from the standard is discovered, corrections can be readily made.

Perhaps the easiest way to get a good picture of the response of a sound system is to plot a curve of the response in db. against the frequency in cycles per second on a semi-logarithmic graph-paper as shown in Fig. 2, A. Here the amplifier has had its natural response changed by filters to overcome deficiencies in recording and to adjust it to the acoustical conditions existing in the theatre where the equipment is installed, thus accounting for the peculiar curve. If this compensation is removed and the readings taken, the curve, when plotted, will take on somewhat the natural response of the system [B in Fig. 2]. A comparison of the two will give the projectionist an idea of how his filter system is responding.

If an irregularity appears in the curves of *both* projectors, the projectionist can be almost certain that the fault lies not in his reproducers but in his main amplifying system or relative equipment used by both reproducers. In this way faulty transformers, weakening tubes, and faulty exciter supply rectifiers can be located and replaced before their complete failure causes a shut-down of the entire system.

Not For Mechanical Troubles

As mentioned previously, this test is to be applied to the electrical and optical parts of the sound system, but is not useful in locating mechanical troubles in the reproducers. Due to

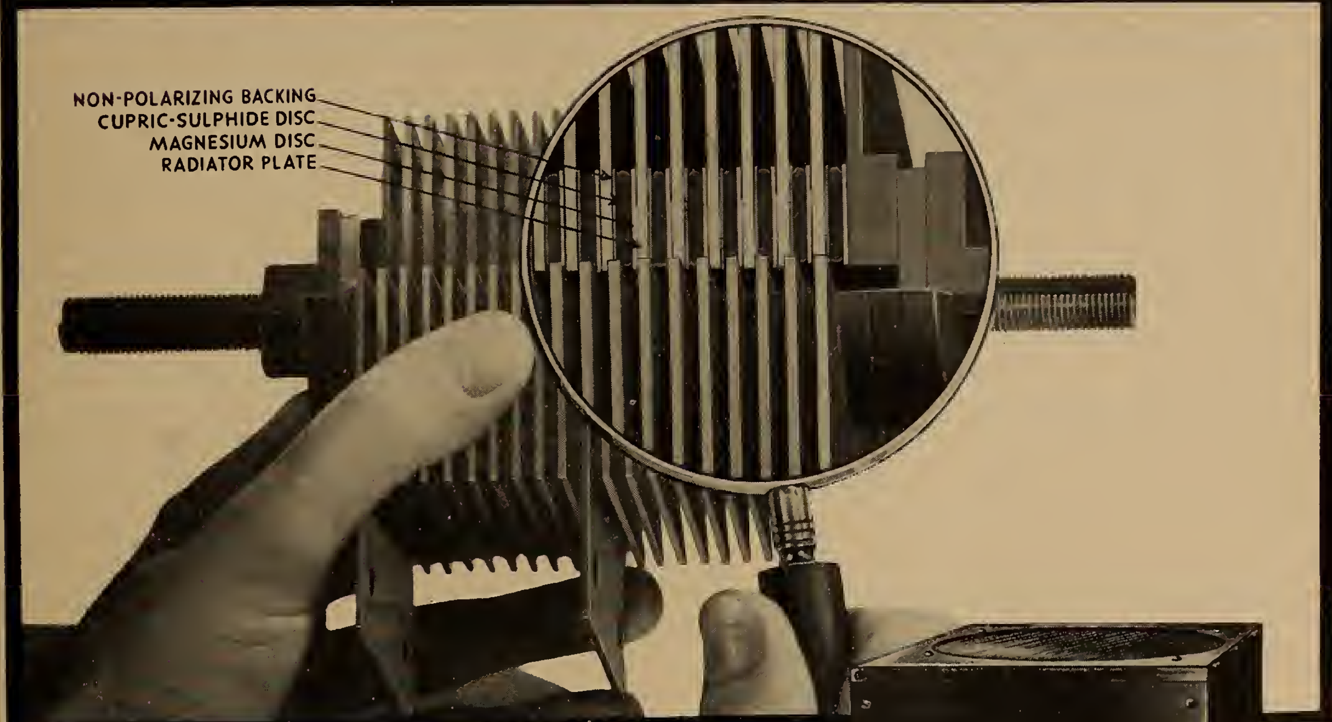
PROJECTOR NO. 1			PROJECTOR NO. 2		
Cycles	Decibels	Without 7311	Cycles	Decibels	Without 7311
1000	+3	+4.5	1000	+3.5	+5.5
50	+12	+4.5	50	+12.5	+5.5
100	+10	+4.5	100	+10	+6.5
200	+6.5	+4.5	200	+7	+7
300	+5	+4.5	300	+5.5	+6.5
500	+4	+4	500	+4	+6
2000	+2.5	+2.5	2000	+3	+4
3000	+2.5	+1	3000	+3	+3
4000	+1.5	−.5	4000	+2	+1.5
5000	−.5	−2	5000	−.5	0
6000	−4	−6	6000	−4	−3
7000	−7	−7.5	7000	−6.5	−4.5
8000	−10	−10	8000	−10	−12
9000	−13	−14	9000	−13	−12.5
10,000	−16	−16	10,000	−15	−14

Voltage readings: Photocell on Projector No. 1, 90 volts; Projector No. 2, 88 volts; P. A. field supply, 32 volts; 555-W unit field supply, 20 volts; exciter lamp supply, 18 volts.

FIGURE 1

Frequencies listed over a range of from 50 to 10,000 cycles, with and without filters. Voltage readings above relate to units which are important sources of e.m.f. in this type of Erpi installation

New DEPENDABILITY

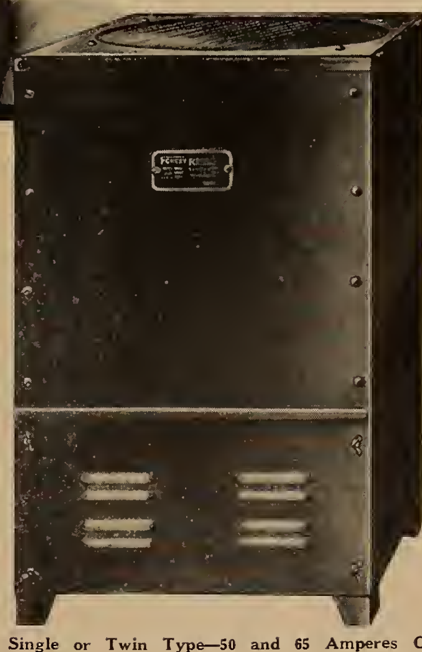


Magnesium - Copper Sulphide Rectifiers

Several years of extensive laboratory and projection room experimentation by Forest engineers, in cooperation with P. R. Mallory Co., have produced this new heavy-duty dependable and economical Magnesium-Copper Sulphide Rectifier.

This new rectifier as presented by Forest, demonstrated in practice and theory, is the solution to the problems encountered in other types of rectifiers and power sources for Suprex projection.

Illustrated is the perfect mechanically constructed Mallory Magnesium-Copper Sulphide rectifying unit similar to those used in the New Forest Rectifier for projection.



Single or Twin Type—50 and 65 Amperes Capacity

★ **TEMPERATURE:**

A superior feature in this rectifier is that no time is required for the rectifier output to build-up, because the output is practically the same at temperatures from 40° F. below zero to 300° F. above zero, regardless of age.

★ **SELF-HEALING AND VOLTAGE OVERLOAD:**

The self-healing characteristic of the rectifying junction causes an immediate re-formation of the rectifying film if abnormal voltage surges occur.

★ **CURRENT OVERLOAD:**

This rectifier has withstood overloading to a temperature of 660° F. at brief intervals without failure. This fact proves that this rectifier can be overloaded to many times its rated capacity should abnormal conditions or emergencies arise, at the same time assuring complete dependability.

★ **REGULATION AND AGING:**

Magnesium-copper Sulphide Rectifiers have a very low internal resistance in the conducting direction. This characteristic results in excellent regulation of the rectifier output voltage over a wide range of load conditions. There is no change in the characteristics of this rectifier as a result of aging, therefore the output of the Magnesium Rectifiers decreases little or none.

SEND FOR NEW ILLUSTRATED CATALOG !

FOREST MAGNESIUM-COPPER SULPHIDE RECTIFIERS

BELLEVILLE
NEW JERSEY

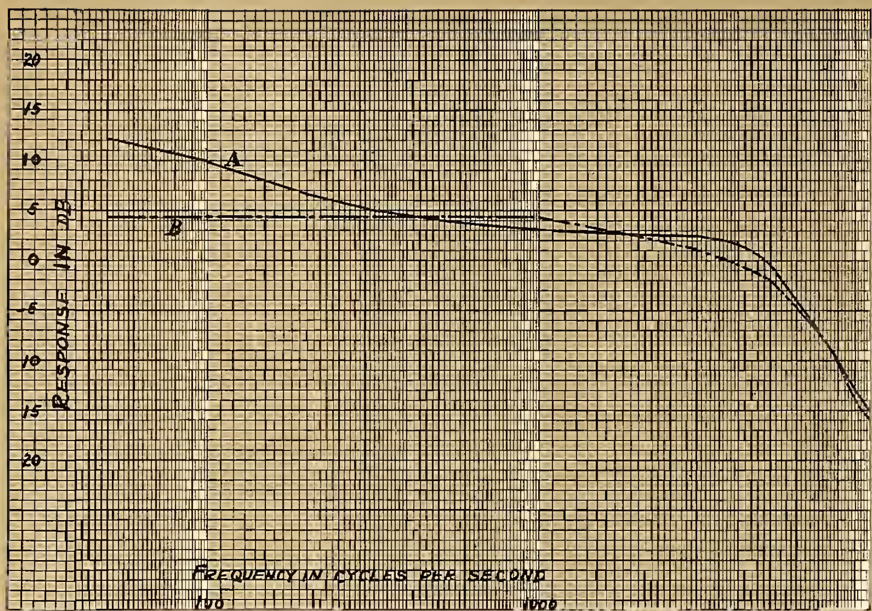


FIGURE 2

A is curve plotted with Erpi 7311 filter compensation. Curve is typical of this installation only. B is curve with filter removed. Slope of curve from 1000 to 10,000 cycles is caused by manner in which test reel was recorded and the film transfer filter in the pre-amplifier. Erpi 86-type amplifier is supposed to be flat within 1 db. from 50 to 10,000 cycles

the fact that the meter is damped in such a way that the pointer will not follow variations above 15 cycles, any possibility of ascertaining flutter caused by faulty or worn mechanical parts is thus eliminated.

It has been my experience that a monthly test of this type is sufficient to maintain the equipment at a high standard. By this means one has a perfect record of the performance of his equipment even to the individual reproducers. It may be added that curves, pictures, and other graphic evidence are impressive and often carry much weight with skeptical managers when one is requesting replacement parts.

Toning, not Tinting, Used on 'Good Earth' and 'Winkie' Release Prints

INDUSTRY trade papers have commented favorably on the "tinting" of all release prints of *Wee Willie Winkie*, the current Shirley Temple starrer for 20th Century-Fox. Latter company got the idea from J. M. Nickolaus of the Metro-Goldwyn-Mayer studios, who applied it successfully to *The Good Earth* release prints. But the process is *toning* not "tinting," says Mr. Nickolaus in a recent paper[1] in which he discusses the procedure and also its effect upon projection. Excerpts from this paper are appended hereto for the enlightenment of those projectionists who may have speculated on the procedure followed:

"Toning a motion picture positive film is an art that has been nearly forgotten. For the past decade very little, if any, toning has been done. The inception of sound photography with its many complicated problems probably had a great deal to do with it, but with the advances that have been made; not only in sound photography but also in laboratory processing, it is not inconceivable that this art might be partially revived.

"Many of the emotional moods that motion pictures seek to portray can not always be depicted to their full extent by the normal gray tone of black-and-white photography, since gray tones can have a very sobering effect upon the observer. While gray no doubt enhances certain moods, there are many instances where color of some sort would enhance the mood and thereby produce a more striking and favorable reaction. Much of the early work in motion pictures made use of color effects produced by the use of tints and tones, either separately or in combination. Every so often a picture is made in which definite mood effects to be depicted could be greatly strengthened by the use of some color medium. The choice of the color, as well as the medium, requires very definite planning.

Use Toning To Create Mood

"When consideration was given to *The Good Earth*, it was felt that normal black-and-white photography did not convey the desired mood satisfactorily. Searching for a means to produce the desired effect the subject of toning the positive print was given consideration, and after much experimental work a solution of the problem was arrived at. To the best of our knowledge this is the first complete major release to be toned in its entirety, and, furthermore, it is the first picture to be so toned in a modern developing machine.

"Because the release prints of *The Good Earth* were completely toned, there is a desire on the part of the studios to tone other pictures indiscriminately. The decision to tone this picture was not arrived at with any thought in mind of eliminating color photography. It is extremely difficult to find a story that has been photographed that is so completely adaptable to toning as was this picture. The subject matter will decide whether other pictures will be similarly treated in the future. The mere application of a tone is not sufficient: a choice of the color resulting from the treatment is most important and vital for depicting the proper mood.

Toning Distinct From Tinting

"*A toned photographic image is quite distinct from a tint*, in that a toned image consists of a color image embedded in a layer of colorless gelatin, so that while the highlights are clear, the shadows are colored. A tone may be applied chemically by the use of an inorganic metallic salt or by the use of a dye. It is, of course, most important that the toned photographic image be as transparent as possible for proper and adequate projection. In this respect some samples of toned film that appear fully toned upon hand-examination, produce a practically colorless effect upon projection. It is important, therefore, when judging a particular tone *to view it upon a projection screen.*

Special Machine Designed

"A toning machine had to be designed and built for the work, using the general idea of a regular developing machine, rearranging the tanks, however, so as to be suitable for the process. The tanks were constructed of Allegheny steel and were set up in a lighted room, as a dark room was not necessary for the operation. For that reason the prints were not toned immediately after they were developed; they were dried first, and then put through the toning machine, air squeegees being provided throughout the mach-

(*Continued on next page, col. 1*)

[1] "Toning Positive Film by Machine Methods." *J. Soc. Mot. Pict. Eng.*, XXIX (July, 1937), No. 1, p. 65.

S. M. P. E. CONVENTION TO MARK MANY TECHNICAL ADVANCES

THE great progress made in motion picture engineering during the past year is strikingly demonstrated in the tentative papers program for the S.M.P.E. Convention, Oct. 11 to 14 at the Pennsylvania Hotel in New York City. Never before has the dual role played by the film engineer been more forcefully shown than in the papers which represent a report of his activities.

Examination of the subjects to be discussed show that progress is about equally divided between the further refinement of present equipment and motion picture techniques and in the development of new equipment for further enhancing motion picture entertainment. Many of the papers are concerned with further improvement of sound equipment, motion picture film, lighting and projection equipment and the techniques for their utilization. Other papers deal with entirely new equipment designed to further the art of the motion picture. Outstanding among the papers of this latter type will be demonstrations of Erpi's Stereophonic Recording and Reproduction from motion picture film records, and a demonstration of three-dimensional motion pictures by G. W. Wheelwright, 3d, of the Land-Wheelwright Laboratories, noted workers with Polaroid.

The convention opens Monday, with a business and general session, followed by an informal get-together luncheon. Monday afternoon a photographic and laboratory session will be held, during which the three-dimensional motion pictures will be demonstrated. The demonstration of stereophonic recording and reproduction will be held at the Bell Laboratories on Monday evening, during a special sound session. Other demonstrations, including recent developments in hill-and-dale recording will be discussed and demonstrated. J. G. Frayne and H. C. Silent, of Erpi, will present a paper on push-pull recording.

Tuesday morning will be devoted to engineering practices, including a paper on vacuum tube engineering for motion picture work by L. C. Hollands and A. M. Glover of RCA. A lighting and studio session will be held Tuesday afternoon.

Important Projection Session

A projection practice session will be held Wednesday morning under the chairmanship of Dr. A. N. Goldsmith, during which many important problems concerned with projection technique and equipment will be discussed and demonstrated. Dr. Goldsmith will lead the discussion with a paper on "The Practice of Projection." Ben Schlanger, N. Y. architect, will present "New Approaches to the Presentation of Motion Pictures." Of great interest to projectionists will be the paper, "Precision All-Metal Reflectors for Use With Projection Arcs," by C. E. Shultz of Heyer-Shultz, Inc., of N. Y., and a paper on "Grading Projectionists," by G. P. Barber of the Government of the Province of Alberta, Canada. Canada alone grades projectionists, the U. S. having exhibited no interest in this system.

There will be no session Wednesday afternoon, giving members and guests an opportunity to visit local laboratories and other places of interest. Thursday will be devoted to an apparatus symposium and manufacturer's announcements, together with a second session on sound recording and reproduction. Of unusual interest is the paper on "Non-Intermittent Projection," by J. F. Leventhal.

A varied program of social events has been arranged, the highlight of which will be the semi-annual banquet on Wednesday evening, Oct. 13, at which time the S.M.P.E. Progress Medal and Journal Award will be presented. A partial list of the papers and demonstrations scheduled follows:

"Producing an Industrial Film," J. A. Norling, Loucks & Norling Studios, New York. (*Demonstration*).

"Further Progress in Film Storage," Capt. J. G. Bradley, National Archives, Washington, D. C.

"A Modern Motion Picture Laboratory," C. L. Lootens, Republic Productions, Hollywood.

"Demonstration of Polaroid Three-Dimensional Motion Pictures," G. W. Wheelwright, 3d, Land-Wheelwright Laboratories, Boston.

"Recent Developments in Hill-and-Dale Recorders," L. Vieth and C. F. Wiebusch, Bell Laboratories, Inc., New York. (*Demonstration*).

"Nomenclature and Specifications, Including Description of the Various Types of Movietone Release," J. K. Hilliard, Metro-Goldwyn-Mayer Studios, Culver City, Calif. (*Demonstration*).

"Film Perforation and 96-Cycle Frequency Modulation in Sound-film Records," J. Crabtree and W. Herriott, Bell Laboratories, New York.

"Push-Pull Recording," J. G. Frayne and H. C. Silent, Electrical Products, Inc., Hollywood.

"Stereophonic Recording and Reproduction from Motion Picture Film Records," Introductory Remarks by J. P. Maxfield, Electrical Research Products, New York. (*Demonstration*).

"Distortion in the Reproduction of Hill-and-Dale Records," M. J. Di Toro, Thomas A. Edison, Inc., Orange, N. J.

"Die Castings and Their Application to Photographic Appliances," C. Pack, Doehler Die Casting Co., New York.

"Vacuum-Tube Engineering for Motion Pictures," L. C. Hollands and A. M. Glover, RCA Manufacturing Co., Inc., Harrison, N. J.

"Spectral Distribution and Color-Temperature of the Radiant Energy from Carbon Arcs," F. T. Bowditch and A. C. Downes, National Carbon Co., Inc., Cleveland.

"Recent Developments in Background Projection," G. G. Popovici, Bronx, N. Y.

"Recent Developments in Gaseous Discharge Lamps," S. Dushman, Research Laboratory, General Electric Co., Schenectady, N. Y.

"The Practice of Projection," A. N. Goldsmith, New York, N. Y.

"Grading Projectionists," G. P. Barber, Government of the Province of Alberta, Canada.

"Cooperation as the Keynote of Successful Small Town Projection," T. P. Hover, Lima, Ohio.

"New Approaches to the Presentation of the Motion Picture Theatre," B. Schlanger, New York.

"Precision All-Metal Reflectors for Use with Projection Arcs," C. E. Shultz, Heyer-Shultz, Inc., New York.

"Commercial 16-mm. Projection Faults," C. L. Greene, Minneapolis, Minn.

"Non-Intermittent Projection," J. F. Leventhal, Leventhal Patents, Inc., New York, N. Y.

"A Device for Cleaning the Sound-Track of Motion Picture Film During Projection," R. V. Fisher, Flower City Specialty Co., Rochester, N. Y. (*Demonstration*).

"The Sound-Level Meter in the Motion Picture Industry," H. H. Scott, General Radio Co., Cambridge, Mass.

INCREASED INDUSTRY PAYROLL

It is estimated that there are more than 10,000 exchange employees, with an annual payroll of $27,500,000. Thus, the varying estimates of increased costs would indicate wage increases as a result of unionization ranging from four to nine per cent.

The unionization of theatre personnel, now in progress, will place a considerably higher burden on the industry, as there are an estimated 240,000 persons employed in theatres in this country.

---

ine to prevent an excess carry-over of water, chemical and dye.

"The machine operates at a rate of 90 to 100 feet per minute, depending upon the length of time required for the toning operation. The toning solution is a chemical one made up with uranium nitrate as the chief constituent. The formula used was that contained in the 1927 edition of 'Tinting and Toning,' which was published by the Eastman Kodak Company.

"The picture *The Good Earth* was approximately 12,000 feet long, consisting of 14 reels. There have been made approximately 500 release prints, and all the prints have been toned. The sound department advised that all tests made by them pertaining to the effect of toning the sound-track showed no detrimental effects upon the quality of the sound."

A New Projection Unit—

THE MAGNESIUM-COPPER SULPHIDE RECTIFIER FOR ARC SUPPLY

By *J. K. ELDERKIN*
COMMERCIAL ENGINEER, FOREST MANUFACTURING CORPORATION

Here is data on a new projection equipment, evidencing distinct possibilities of widespread application in projection work, as given by an acknowledged authority on rectifiers. As with all new projection equipments, I. P. facilities are at the service of any reader desiring further information anent the design or operation of this unit.

THE magnesium-copper sulphide rectifier is of the dry-disc type, *all metal* in construction and containing no fibre or phenol insulators, no glass, no liquid and no moving parts. It is entirely noiseless in operation and produces no radio interference. The rectifier consists of an assembly of magnesium discs, copper sulphide discs and a combination of terminal and radiator plates which assist in dissipating the heat developed in the rectification process. Fig. 1 is a cross-sectional view of a typical rectifying junction with its associated steel radiator plates.

Operation: The rectifying action occurs at the junction interface, and being electronic in nature assures permanence and stability of the rectifying elements, with no odors or gases being liberated at any time. Current will flow freely in the direction of the arrow, as indicated in Fig. 1, or from the copper-sulphide disc to the magnesium disc; but the resistance to the flow of current in the reverse direction—that is, from the magnesium disc to the copper-sulphide disc—is very great, thus the rectifier serves practically as a unidirectional conductor or valve. A commercial rectifier of this type consists of a number of these junctions stacked in series on a steel bolt or stud. The voltage output required determines the number of junctions in any one stack.

Size and Capacity: The magnesium copper sulphide rectifier discs are made in several sizes capable of handling from a few amperes up to several hundred amperes per disc, thus rectifiers of a very large ampere-capacity can be made without resorting to connecting a number of rectifying junctions in multiple—*a feature not found in other types of dry-disc rectifiers.*

Life: The operating life of any dry-disc rectifier is related directly to the temperature at which the rectifier is normally operated. One of the outstanding features of the magnesium copper sulphide rectifiers is its ability to operate continuously at much higher temperatures than any other types of dry-disc rectifiers without impairing or destroying those characteristics essential to long operating life.

In the case of other metallic rectifiers there is a difference between the operating temperatures when the units are new and when aged. Since other dry-disc units are very sensitive to heat, they must be designed with enough discs in multiple to withstand a temperature they will reach ultimately when aged.

The amount of current that can be carried by other metallic rectifiers—for instance, the oxide type—without raising their temperatures to a critical value is so low that in order to carry appreciable current a large number of discs must be connected in multiple. It is obvious that the greater the number of discs in multiple in a rectifier the greater the liability for breakdown. The breakdown liability in a unit having, say, 25 discs or sections in multiple is 25 times greater than a unit having only one disc or section, because the breakdown of any one of the 25 multiple sections puts the entire group out of service.

Magnesium copper sulphide rectifiers are made in sizes and capacity that require only a single section to carry the required current, instead of a large number of sections connected in multiple. Extensive tests conducted over a period of years indicate that, when the sulphide-type rectifier is properly operated, its life is practically unlimited.

Temperature: As previously stated, the life of a metallic-type rectifier depends upon the temperature to which it is subjected in service. The normal operating temperature of the magnesium copper sulphide rectifier for maximum life should not exceed 180° F., a temperature that would be injurious to any other metallic-type rectifier. Although not recommended for maximum life expectancy, an operating temperature as high as 265° F. is permissible for a short period of time without damage to the copper-sulphide unit. Many magnesium copper sulphide units have operated continuously at 185° F. for a period of time now in excess of 10,000 hours, which in projection service would be more than five years. This remarkable rectifier has been severely overloaded to the point where temperatures as high as 660° F. have been obtained for brief intervals, without failure. This fact proves that this rectifier can be overloaded to several times its rated temperature and capacity without failure, should abnormal conditions or emergencies arise.

This feature of being able to withstand abnormal and extremely high operating temperatures for short periods of time is to be found only in the magnesium copper sulphide rectifier. It is a very important feature in rectifiers for projection use because the rectifier may be, and frequently has been located where the room temperature reaches 115° F.,

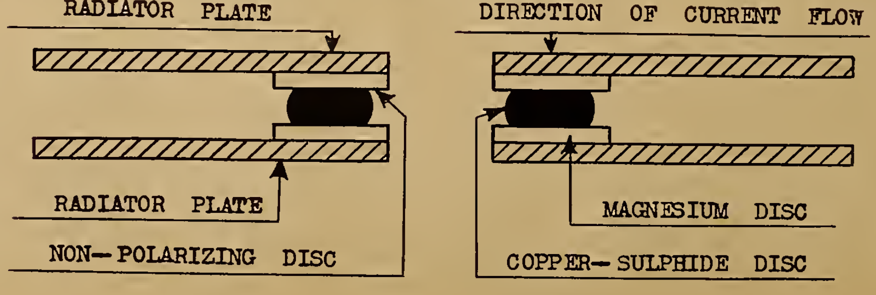


FIGURE 1

a condition which will have little or no effect upon the output, efficiency and life of the copper-sulphide unit.

The magnesium copper-sulphide rectifier is sealed internally as well as externally by a special compound which protects it completely against external conditions such as high humidity, dust and oil.

Self-Healing Characteristic and Voltage Overload: The rectifier junction has a self-healing characteristic not found in any other dry-disc rectifier. The rectifier is designed with the proper number of junctions to assure long continuous service with regard to the applied voltage and to withstand the voltage surges commonly experienced under ordinary service conditions. If an abnormal surge is applied to the magnesium copper-sulphide rectifier, it may possibly break down for an instant; but it will reform immediately with no apparent interruption of the output current and with no damage to the rectifier. Other metallic rectifiers under the same conditions, and with much lower surge voltages applied, will break down, and because they are not self-healing, will remain broken down until the unit is replaced.

Regulation and Aging: Sulphide rectifiers have a very low internal resistance in the conducting direction. This characteristic results in excellent regulation of the rectifier output voltage over a wide range of load conditions. With a correctly designed transformer, the output voltage can be held to an almost constant value.

Unlike other types of dry-disc rectifiers, which experience a change in characteristics as a result of aging, the output of the sulphide rectifier decreases little or none. Throughout their life, and also over wide ranges of load and ambient and operating temperatures, their efficiency remains practically constant. Another superior characteristic is that no time is required for the rectifier output to build up. The output will be practically the same at temperatures from 40° F. below zero to 300° F. above zero, regardless of age. Other dry-disc rectifiers require from one to four minutes to reach normal current outputs, according to their age and operating temperatures.

Projection Application: Magnesium copper-sulphide rectifiers are ideal for supplying direct current for the projection arc, as their particular characteristics lend themselves perfectly to the conditions which a rectifier for this purpose is called upon to meet. A rectifier for arc supply will consist of a 3-phase transformer of proper design, protective fuses between the transformer and rectifier units, remote control switches, a circulating blower fan and the rectifying units. All of these elements are common to present dry-disc rectifiers, but because of the superior and entirely different characteristics of the sulphide rectifier units, not found in other dry disc units, a trouble-free, dependable and long-life rectifier is now available.

A resume of the magnesium copper-sulphide rectifier characteristics reveals that conditions commonly encountered in projection practice will in no way affect the life of this rectifier. For instance, ambient temperatures far below or above those encountered in any projection room or rectifier room will produce little, if any, effect on operating efficiency and life. Severe overloading that will destroy any other type of metallic rectifier will only cause the sulphide type to operate at slightly higher temperatures, but without permanent injury, due to the abnormally high temperature these units are able to withstand for short periods of time.

Fan failure in any other dry-disc rectifier would result in the destruction of that unit in a very short time, because of the inability of such a unit to withstand the ensuing elevated temperature; but an equally elevated temperature will not permanently affect the sulphide type. In fact, sulphide rectifiers have been operated at full load without the fan for several days without injury to the unit. Tests conducted over long periods of time have shown that the sulphide type rectifier will withstand unusual abuse yet continue in perfect operation.

These unusual operating features of the sulphide rectifier indicate that they will furnish satisfactory service in case of an emergency without in any way impairing their usefulness.

The magnesium copper-sulphide rectifier as constructed by the manufacturer for projection arc supply consists of 6 half-wave sections with a pair of sections mounted on a common bolt, bridge-connected to a 3-phase supply, giving full-wave rectification on all three phases. Each of the 6 half-wave sections is a single rectifier having 14 rectifying junctions in series, as contrasted with a multiple of from 18 to 36 rectifiers in the case of other dry-disc rectifiers. It is apparent that, with everything else being equal, a multiplicity of units means a multiplicity of chances for failure. For example, other dry-disc rectifiers have as many as 216 individual rectifier sections for a given current output, whereas the sulphide type has only 6 individual rectifiers.

While the requirements for carbon arc supply rarely exceed currents of 65 amperes at the present time, it is of interest to note that in other commercial applications, such as heavy current railway battery chargers and arc welders, these magnesium copper-sulphide rectifier units have been successfully used where the current output is many times that required by the carbon arc application, and at comparable voltages.

Laws of Resistance

By *JACK K. LEATHERMAN*

MEMBER, PROJECTIONIST L. U. 511, JACKSONVILLE, FLORIDA

RESISTANCE probably enters into the projectionist's work more than any other single item (excepting poor prints) and for that reason he should be familiar with laws that govern same. A good beginning for a discussion on resistance is Ohm's law, which states that the current flowing in a circuit is equal to the pressure divided by the resistance. Expressed in formula form it is: $I = \frac{E}{R}$; where I is the current in amperes, E the electro-motive force in volts and R the resistance expressed in ohms. From the formula it will be noted that by means of a little algebraic juggling it can be expressed as $R = \frac{E}{I}$ and $E = I\,R$.

Series Resistance

In a series circuit resistance units are so connected one after another that the current is obliged to pass through each in turn before returning to its source. The total resistance of a series circuit is expressed as $R_t = r_1 + r_2 + r_3$, *etc.*; in other words, the sums of all the resistances. In a series circuit the current is the same in all parts of the circuit, whereas the voltage varies across resistances of different values. The combined total of voltages across the resistors is equal to voltage applied to the circuit.

To illustrate: Given two resistances in series across a 115-volt line. $r_1 = 25$ ohms, $r_2 = 35$ ohms. Required to find the current in the circuit and the voltage across each resistor (Fig. 1). Finding total resistance: $R_t = r_1 + r_2$. Substituting: $R_t = 25 + 35$, or 60 ohms. Using Ohm's law to determine the amperage in circuit:

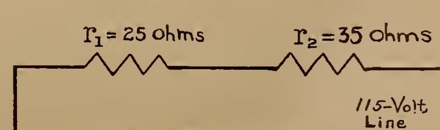


Figure 1

$$E = IR$$

Substituting: $115 = I\ (60)$

$$60\ (I) = 115;\ I = \frac{115}{60}$$

$$I = 1.9166 \text{ amps.}$$

To find the voltage across resistors r_1 and r_2 respectively:

$E = IR$
$E = 1.916\ (25)$
$E = 47.915$ across r_1
$E = IR$
$E = 1.916\ (35)$
$E = 67.081$ across r_2

The total voltages across the resistors equal the applied voltage: $E_t = 47.915 + 67.081 = 114.996$ volts.

Voltage Reduction by Resistance

Quite often a projectionist finds occasion to reduce a given voltage to meet certain requirements. For instance, we wish to operate a 205-D tube from a winding of 15 volts (assuming winding has capacity to handle tube current drain). If the tube is to be worked at 5 volts, this means we must produce a drop of 10 volts; and resistance is the answer. The question is, how much resistance?

Using Ohm's law: $E = IR$; E = voltage drop; I = filament current in amps., and R = resistance in ohms needed to produce desired drop.

Solution: $E = IR$

Substituting: $10 = 1.6\ (R)$ filament current 1.6 amps.

$$1.6R = 10;\ R = \frac{10}{1.6}$$

$$R = 6.25 \text{ ohms}$$

Therefore it will be necessary to use 6.25 ohms of resistance in series with the filament circuit to reduce the 15 volts to 5 volts.

Parallel Resistances

When a circuit branches into two or more resistances and reunite, the resistances are said to be in parellel or multiple. The formula for solution of parallel resistance is somewhat more complicated than that for series units. Expressed in its most common form, it is:

$$\frac{1}{R_t} = \frac{1}{r_1} + \frac{1}{r_2}$$

It may also be expressed thus:

$$R_t = \frac{r_1\ \ r_2}{r_1 + r_2}$$

In parallel circuits the current varies through different resistors, and the combined current through all the resistors equals the total current flowing in the current. The voltage across any resistor in a parallel circuit is the same. For example: Two resistances are connected in parallel across a 40 volt line. $r_1 = 12$ ohms, $r_2 = 24$ ohms. Determine total resistance, total current flowing as well as current through each resistor (Fig. 2).

Finding total resistance:

$$R_t = \frac{r_1\ \ r_2}{r_1 + r_2}$$

Substituting:

$$R_t = \frac{(12)\ (24)}{12 + 24}$$

$$R_t = \frac{288}{36}, \text{ or 8 ohms total resistance}$$

To find total current flowing:

$$E = IR$$

Substituting: $40 = 1\ (8);\ 8\ (I) = 40$

$$I = \frac{40}{8}, \text{ or 5 amps. total current}$$

Finding current in each resistor:

$$E = IR$$

$$40 = I\ (12);\ 121 = 40$$

$$I = \frac{40}{12} \text{ or 3.333 amps. in } r_1$$

$$E = IR$$

$$40 = I\ (24);\ 241 = 40$$

$$I = \frac{40}{24}, \text{ or 1.666 amps. in } r_2$$

Total currents through resistors in parallel equal the total current flowing in circuit. Check: Current in r_1 and $r = 3.333 + 1.666$, or 4.999 amperes, total current flowing in circuit.

Resistance of Conductors

The resistance of a wire is directly proportional to its length and inversely proportional to its cross-sectional area. In other words, as the length of a conductor is increased its resistance is also increased, and as the area of conductor is increased its resistance is decreased. For purposes of comparison, the relative area of wires is expressed in circular mils, meaning the square of the wire diameter in mils (mil = .001 inch). A No. 12 solid wire has a diameter of approximately 80.8 mils; squaring this $(80.8)^2$ we get 6528.64 circular mils.

The formula used for determining the resistance of conductors is: $Rd^2 = Kl$, also some times expressed as:

$$d^2 = \frac{Kl}{R};\ R = \frac{Kl}{d^2}, \text{ and } l = \frac{Rd^2}{K}$$

R represents the resistance of the line

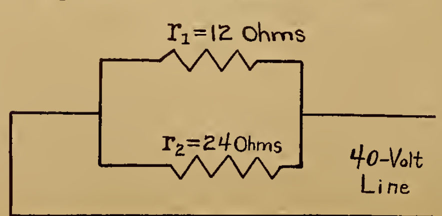


Figure 2

in ohms; d^2 is the area of the wire in circular mils; K is the resistance constant, depending on kind of wire used (copper constant = 10.8; german silver 200, *etc.*) and l is the total length of line in feet.

A few problems to illustrate the application of this forula are appended hereto. *Problem* 1. A motor drawing 5 amperes is located 100 feet from the main switch box. A pair of No. 14 wires are used for a line, and the voltage at the main switch is 110. What is the voltage at the motor? Solution:

$$R = \frac{KL}{d^2};\ \text{Substituting: } R = \frac{10.8\ (200)}{4107}$$

Explanation of formula values: 10.8 = copper constant; 200 = 2 wire line 100 ft. long; 4107 = circular mils in a No. 14 wire; $R = \frac{2160}{4107}$; $R = .525$ ohms, resistance of entire line.

Finding the voltage-drop: (E = drop); E IR; E 5 (.525); E 2.625 voltage-drop produced by the resistance of the wire.

Voltage at motor = 100 — 2.625, or 107.375.

Problem II. Suppose we wish to run a two-wire line to a generator drawing 10 amperes 200 feet away. The voltage at the switch box is 110. What size wire shall be used if a line drop of 2% is allowed? Determining line drop: 2% of 110 = 2.2 volts. Using Ohm's law to find resistance of line with a 2.2 volt drop:

$E = IR$ (E = voltage drop); $2.2 = 10R$

$$10R = 2.2;\ R = .22 \text{ ohms}$$

This means the total resistance of line must be .22 ohms if a drop of 2.2 volts is not to be exceeded. Using the formula to find wire size:

$$R = \frac{Kl}{d^2}$$

$$\text{Substituting: } .22 = \frac{10.8\ (400)}{d^2}$$

$$.22d^2 = 4320$$

$$d^2 = \frac{4320}{.22}$$

$$d^2 = 19636.3 \text{ circular mils}$$

By consulting a capacity gauge table we find that 19636.3 circular mils lies between No. 6 and 8 wire. No. 6 wire will naturally be selected to keep the drop from exceeding 2%.

NOTES *from the* SUPPLY FIELD

★

HALL & Connolly, manufacturers of projection arc lamps for fifteen years have produced a new 125-ampere, high-intensity lamp designed the HC-11. All service tests having been passed successfully, the lamp is now in general production and is ready for delivery. Details of this lamp follow:

General Construction. Non-ferrous, non-corrodible metals have been used in both the housing and burner unit where-ever possible. Where necessary to use sheet steel, a heavy coating of chromium on both sides of the sheet is provided. This, together with the special heat- and moisture-resisting enamels used, forms a finish that will retain its lustre for years.

The lamphouse is streamlined to some extent, but ventilation requisites have been observed. All corners are well-rounded to aid appearance and accessibility. Doors are long and narrow, hinging downward out of the projectionists' way. All hand controls are conveniently located on the rear end plate of burner; while all controls for handling the spot on the aperture are at the front end of housing. All fittings are of substantial and durable construction.

The burner element itself is more sturdy and heavy than H. & C. old-type outfits. Improved materials and methods of application are expected to make this lamp well-nigh indestructible through ordinary usage.

Magnetic Effects. There is a complete absence of disturbing magnetic effects, which occasion unsteady light at times.

Arc Feed Regulations. Greatly improved feed regulation is accomplished by a special voltage-sensitive motor with a relay. An optically-controlled thermostat, used formerly on some lamps, was found to be inadequate for finer and more accurate regulation. The new system gives proper regulation from the instant the arc is struck, without lag as heretofore.

Arc Starting. Semi-automatic means for instantaneously striking the arc without danger of breaking the carbon or crater are provided.

Full 22" Trim. The positive carbon holder carriage has an exceptionally long travel, with safe and convenient grip on the carbon end. It is impossible to break the carbon when tightening up. Quick carriage release and release of contacts is provided. Carbon waste due to holder is only ½". Ball and roller bearings are used in the rotating carbon holder.

Carbon Feed Motor. This motor is located on the outside of the rear end plate of the burner, but as a part of the burner element. Outside mounting avoids lamp fumes, prolongs life and improves performance.

Carbon Feeds Independent of Friction Drive. Both carbons are positively driven. Either carriage is driven along rigid tracks, and there can be no slippage or variation from straight-line travel. There are no feed rollers to worry about. All feed and rotating parts are remote from arc heat, and mechanical failure is extremely unlikely.

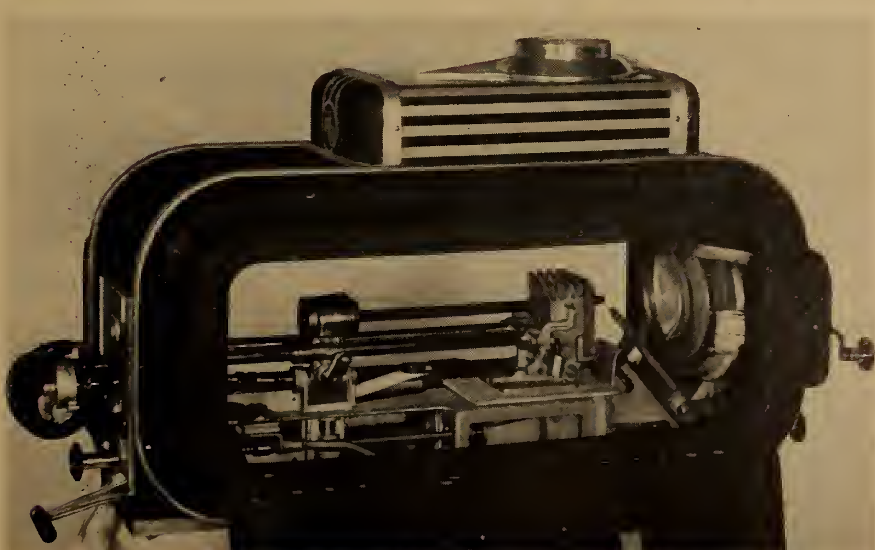
Separate Feeds. The negative feed may be varied by infinitely small steps without affecting speed of positive rotation and feed—of great importance if it is desired to vary the current or change the type of carbon. It should be remembered that even a slight change in amperage upsets the relative burning ratio of the two carbons.

Condenser Lens Mounting. The condenser holder is securely mounted in a fixed position to the front lamphouse casting and is at all times accurately on the optical center in exact line with the aperture and lens. Uniformly good screen results cannot be obtained when condensers are moved vertically or laterally to focus the spot.

Lamp Burner Mounting. For focusing the spot in the only optically-correct way the HC-11 burner is adjustably mounted in a carriage pan for movement back and forth with respect to the focal length of the condensers; and the carriage pan, in turn, is arranged for lateral and vertical movement by means of hand knobs. Thus, the light source moves, but not the lenses.

Burner Unit Removable. The burner control and wiring, as a unit, slides into the lamphouse on tracks through an opening in the rear end of the lamphouse.

Of great importance is the fact that special provision has been made to accommodate future improved condenser lenses. The lamphouse and lens mountings of the HC-11 will accommodate any diameter or focal length condensers that might be developed. An 8-inch diameter combination is now being made experimentally and will be tested soon.



Interior view of new H.C. 11 high-intensity arc lamp

FOREST MAGNESIUM-COPPER SULPHIDE M.P. RECTIFIER

A new magnesium-copper sulphide rectifier is being manufactured and is now ready for general distribution by the Forest Mfg. Corp., of Belleville, N. J., under an exclusive motion picture license from the P. R. Mallory Co. Details of this new unit are presented in an article appearing elsewhere herein. Forest has specialized in rectifiers for 25 years and recently manufactured and distributed the copper-oxide rectifier for projection work.

NATIONAL CARBON BOOKLET

National Carbon Co. is offering to I. P. readers a free booklet, "The Eternal Triangle in Picture Projection," as part of its campaign to extend the use of the Suprex-type arc, now known as Simplified High-Intensity Projection. Simply address requests for this extremely interesting booklet to National Carbon Co. at Cleveland, Ohio.

WEAVER ELECTRIC CHANGE-OVER

A new electric change-over which, its manufacturer asserts, is the fastest-acting and quietest ever made, is being offered by the Weaver Mfg. Co., 1639 East 102nd St., Los Angeles, Calif. This change-over is suitable for use with either front- or rear-shutter Simplex projectors. Motiograph and Universal dousers are also available. The unit is offered on a 30-day free trial basis.

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

THE granting of licenses by Erpi to International Projector Corp. and to Motiograph, Inc., to manufacture and distribute, under all Erpi and W. E. patents, sound reproducing equipment, from soundheads to horns, in the domestic field is seen in informed quarters as presaging the early withdrawal of Erpi, meaning A. T. & T., from the sound reproducing field. Erpi insists that it will remain in the reproducer field, but its assertions on this point are not too emphatic and are not considered seriously by competent observers. Erpi will continue to administer its producer recording licenses, of course.

Thus, by a circuitous route, the sound reproducing business seems destined to wind up in projection hands. The effect of this deal on the fortunes of both International Projector and Motiograph is incalculable at this time, although the former may enjoy a competitive edge through its direct affiliation with manufacturers of other projection equipment and with its own distributing organization, National Theatre Supply.

International is also licensed under all existing RCA patents, with Motiograph now striving to close a similar deal. Under the terms of the deal both licensees can either manufacture equipments in their own plants, or they can buy complete units or any and all component parts from Western Electric for resale.

Both Companies Already Selling

Both companies lost no time in getting their sales campaigns under way, and are now offering both the W. E. 211 and the W. E. heavy-duty Mirrophonic outfits in the market. International has the bulge at the moment through being able to employ the RCA rotary stabilizer head, which Erpi never had. Should Motiograph obtain equal rights under an RCA license, the deal would even up all around.

It is expected that both International and Motiograph will make some changes in existing Erpi and RCA equipments, which privilege is theirs under the terms of the licenses, and it is known definitely that International will design an entirely new soundhead. Neither licensee has indicated its attitude on the servicing question, but it is known that they expect to treat this problem exactly as they have treated projector mechanism servicing for many years—that is, leave the servicing to the individual theatre and afford servicing when requested at a flat rate per hour. This program places the servicing burden on the shoulders of Mr. Exhibitor, which, simply expressed, means Mr. Projectioninst.

This means the collapse of the grandiose but impractical scheme of a national servicing organization which would employ hundreds of servicemen and reap a harvest (supposedly) through service fees and the sale of replacement parts. This means, also, a wide-open market for replacement parts in the future, since neither International nor Motiograph are in a position to employ any such device as the R. & R. contract conceived by Erpi. Through the medium of the R. & R. contract Erpi was able to sweep the field pretty clean of independent replacement part distributors, but there still may be a few in existence (such as G-M Laboratories which makes the Visitron photo cell) who are in a position to cash in on current developments.

Further developments in the sound reproducer equipment field will be recounted herein from time to time.

I. A. Claims Control Over All West Coast Studio Workers

The I. A. T. S. E. exploded a bombshell on the industry labor front during the past month when it announced, through William Bioff, personal representative of Pres. George Browne and director of I. A. West Coast activities, that it intended to assume jurisdiction over every department and classification of labor in the production of motion pictures, including writers, actors, directors, publicists, artists and illustrators, gardeners, watchmen, tailors, librarians, policemen—the list grows long without encompassing all the studio workers. Simultaneously, I. A. demanded that the I. A. seal appear on all film in distribution after Sept. 18.

The immediate outward reaction of the producers to this announcement was one of puzzlement; but there could be no doubt as to the attitude of several groups among those over which the I. A. claimed jurisdiction. The Studio Actors Guild, Screen Writers Guild and the Screen Directors Guild issued a joint statement which, in effect, derided the claims of the I. A., asserted that they would continue to manage their own affairs, and suggested politely that the I. A. mind its own business. These groups were joined later by the Screen Publicists Guild and the Artists and Illustrators, both of whom laid down a heavy word barrage against the I. A. Also anti-I. A. are the film editors, set dressers and interior decorators.

The bitterness apparent in the fight was reminiscent of the recent victorious battle by the I. A. against Federated Motion Picture Crafts, the leader of which, Charles Lessing, was finally deposed through I. A. pressure. United Press dispatches to newspapers throughout the country featured Guild charges against the I. A. and also played up to reports of alleged unrest among the memberships of West Coast locals. Throughout the deluge of statements and counter-statements the I. A. leaders remained calm and indicated that nothing would deter them from their goal. Interviewed in New York, President Browne said: "With everybody claiming jurisdiction over everything, I claim jurisdiction, too."

Guilds Termed 'Do-Nothing'

The Screen Actors Guild, an A. F. of L. affiliate, appeared to be in a particularly strong position because of its 10-year contract recently negotiated direct with the producers. The Guild characterized I. A. claims as "nonsense," because I. A. couldn't claim jurisdiction "over a field in which it had no members." The I. A. promptly replied that it had signed up 2,000 minor workers within a few days, tacking on to this a statement by Harland Holmden that the Guild represented only the brass-hat stars, that it failed to protect the interests of its minor worker members the while it held onto them for what strength it could derive therefrom, and that the various studio guilds in general had given their memberships just one thing—nothing.

The controversy is expected to continue indefinitely or until such time as the producers, the I. A. and the various guilds all sit down together and iron out the situation. Almost overlooked in the general rumpus was the notice serve blandly by the I. A. on all studios that the continuance of the practice of giving screen credit to A. S. C. cameramen would be highly displeasing to I. A.; in fact, it would not be acceptable. First cameramen, a majority of whom belong to A. S. C., are not included in the I. A. closed shop agreement covering cameramen.

'New' Nazi Depth Process

Zeiss-Ikon, of Germany, has perfected a new process of making pictures in "relief." The process utilizes polarized light. The films in relief are noted by the aid of "normal lenses which are coated with a simple greenish reflect" and which are covered with microscopical crystal.

To obtain the polar effects, the vertical lense catches the horizontal one which serves as a polar filter. One of the eyes seizes vertically the image, the other, horizontally, absorbs the polarized light. The picture is registered on the film by

a double "objectif" in such manner that the lenses adapt themselves to the image through one of the lenses, the other serving to catch the polarized light.

There is nothing new or novel about these German experiments to American workers in the art.

80% Using Dual Bills

About 80 per cent of the nation's theatres are now playing double bills, it is estimated by John O'Connor, RKO film buyer. All RKO houses with the exception of some in Ohio are showing duals.

'It Can't Happen to Me'

The Tryon Theatre, Spartanburg, S. C., was razed by fire with $15,000 equipment and $20,000 building loss. Flames broke out in projection room at night show with several hundred patrons escaping into street minus injuries. Ushers and P. Pressley, projectionist, credited with orderly manner in which patrons filed safely out. Pressley gave a quick alarm, and then found his escape cut off by flames and crawled out on the roof through a ventilator. He was the only person injured. Theatre equipment was a total loss.

New M. P. Almanac Packed With Industry Data

The motion picture industry's considerable contribution to national economic welfare is reflected by an increase of 9,500 permanent employees in the past year, a ten-million-dollar expansion in picture production costs, and a $7,800,000 rise in the payroll of Hollywood alone, according to the 1937-8 edition of The Motion Picture Almanac, just published by Quigley Publications.

465 New Theatres in Year

There were 465 new houses built between April, 1936, and June, 1937. In dollar terms, from 1929 to June of this year, theatre construction, including remodeling, brought an expenditure of an estimated $424,914,000, almost a half billion dollars. New employment ranged from an increase of 18,436 placements of "extras" in Hollywood, to 4,500 more in theatres (880 more houses operating than a year ago), and a similar number of additional jobs in the distribution branch.

The average admission price rose 1½ cents, and between 83,000,000 and 88,-000,000 tickets were bought weekly at 22 cents average, most of them between 7:30 and 8:30 in the evening. The average ratio of population to seats in 93 cities of more than 100,000 population is 8.9, and for the country as a whole, exclusive of large cities, it is 14.4.

Disney Cartoon Feature Due

The first Walt Disney all-color cartoon feature, "Snow White and the Seven Dwarfs" will be ready for Xmas showings. Disney said that production costs would reach $1,200,000, with 85% of this sum representing labor costs. It will run for 1½ hours. It will utilize what Disney describes as a multi-plane camera technique, giving it the illusion of depth, accomplished by the construction of sets in perspective and the use of lights on each plane.

Academy Sound Track Data

The Academy is preparing a bulletin for release to all theatres in the United States and Canada, illustrating the ten different kinds of sound track now being used by the studios for release prints. The bulletin will contain illustrations of the various kinds of tracks—standard variable density, standard variable area, single and double squeeze tracks, variable density and variable area push-pull, and the various types of noise reduction tracks.

Roy Brewer Heads Nebraska Federation of Labor

Roy M. Brewer, president of I. A. Local 586 at Columbus, Nebraska, was recently elected president of the Nebraska State Federation of Labor by a unanimous vote. This is Brewer's second term in this office, he having served previously in 1933-34, when he resigned to accept an executive position with NRA.

To Color 10% of Total

Technicolor is now working on a process for reduction of 35 mm. film to 16 mm. and expects to have it perfected within two years. Technicolor is now doing a substantial business in the commercial field.

From present indications, Technicolor may handle 10 per cent of Hollywood's total print business in 1938, it is estimated.

Final Exchange Pacts Closed

Wage and hour schedules for 10,000 have been established in the 33 exchange centers with the closing recently of agreements covering Los Angeles and Chicago exchange workers. The negotiations were conducted in New York between a producers' committee and I. A. delegates from the various centers. No date has been set for the setting-up of a master contract to include uniform scales for all exchange workers.

Tube Elements Now Made of Low-Cost Metals

Filaments and grids need no longer be made of the expensive metals formerly required. Modern filaments or cathodes, for instance, no longer require platinum as used in earlier oxide-coated tubes. Pure nickel or an alloy thereof, coated with an activated film of alkaline earth oxide and heated directly or indirectly, provides better emission in the low potential tubes. Several alloys have been developed to meet the requirements as to operating temperature, feasible diameter and elongation. For higher potential tubes, of course, thoriated tungsten or pure tungsten is employed.

For the grids formerly made of costly molybdenum wire, manufacturers now have such alloys as nickel-chromium or manganese-nickels or even the specially developed nickel-iron-molybdenum, providing excellent high-temperature characteristics. For anodes or plates, carbonized nickel is a popular choice in the usual tubes, while molybdenum, iron or pure graphite, and sometimes copper, may be used in the larger tubes.

In short, tube designers and manufacturers have a wide choice of tube materials available, so that they are no longer obligated to alter their designs to accommodate certain fixed and limited materials heretofore available.

SOME TYPICAL TROUBLES IN MODERN SOUND UNITS

(*Continued from page* 11)

Actually, it appeared, vibration had loosened the adjustments in the course of many months, and p.e.c. voltage had become progressively lower.

To facilitate the business of checking p.e.c. voltage as a matter of standard routine it was determined to use tiny neon bulbs. Not all such lamps will light at 90 volts d.c., the p.e.c. potential used in this theatre. Each gas—neon, argon, *etc.*,—has its own flash voltage, which is needed to set it into ionization. Once it has been ionized, the gas will continue to glow at voltage much lower than its flash voltage, thus, it is relatively easy to start such lamps with a.c., in which the r.m.s., or effective voltage, is only .707 of the peaks.

Utilize Tiny Neon Bulbs

However, a number of these lamps are specially built to ionize comparatively low d.c. voltages. Inquiry among suppliers revealed the existence of small bulbs that would light up at the voltage and current available in the p.e.c. circuits of the system in question. These were wired across the p.e.c. supply, in series with a single-pole, single-throw switch that kept them out of the circuit except when the switch was closed. They fail to light when the photo-cell voltage drops below 82 or 83, and thus provide a cheap and entirely satisfactory indication. The switches are needed to keep them disconnected when sound is on (they would short-circuit the amplifier input) but permit instant check-up as part of the standard pre-show routine.

CANADIAN COMMISSION KILLS 2-MEN LICENSED SHIFTS

(*Continued from page* 19)

projection lamp if the film is stationary before the aperture for a period of from two to three seconds.

If the ordinary rate of speed of the film passing through the aperture is maintained, there is no danger of fire at the aperture. If the speed of the machine is lessened, the automatic shutter falls and the film will not ignite; if the film stops, it will ignite. The film may slow up or stop while the machine remains in motion at the usual speed. In such case the automatic shutter will not fall. If the fire takes place, it usually occurs at the aperture but fre-

quently does not extend beyond there, the result being that only a small patch of film is burned. If the film is in motion, however, it may extend beyond the aperture into the projection head, and from there to the upper magazine or into the sound chamber, and from there to the lower magazine.

Film travels at the rate of 90 feet per minute, and at that speed there is no danger of fire. Film may become bunched up or piled up in the projector head or the sound head, and if the fire spreads there, it will burn very quickly and produce dangerous smoke fumes. In addition to the automatic shutter which falls and closes off the light when the speed of the machine falls below a certain point, there is a hand-shutter or hand-dowser which the operator can use in case of trouble. There is also a foot lever for stopping the machine.

Danger Minimized Recently

The film has been much improved and the danger minimized in recent years. The most that can happen if the fire extends beyond the aperture is that the film in the upper and/or lower magazine will burn up. The fumes will be carried away from the projecting room by the ventilating system, and little damage will be done. The ports can be closed by the operator in the event of the fire by a master release cord.

There was some evidence of the danger from explosion. I do not consider there is any appreciable danger from this source. To quote again from the Report of the National Research Council, as follows:

"There ought to be no danger from explosion if the operator stops the arc in case of fire—if the ventilation is effective and if the quantity of films kept in their containers is limited to one or two programs."

There are cases where the film has caught fire from other causes than from the direct heat of the lamp at the aperture; but this occurs infrequently. The chief source of danger from fire is at the aperture, which may spread as previously stated if the film is in motion.

Should a fire occur at the aperture, in most cases it will not extend beyond there, if the aperture gate is closed; but should it do so, the projectionist can probably extinguish it by tearing off the burning portion of the film, and, if necessary, by using the hand extinguisher; and failing that, providing that the fire has extended to the upper or lower magazine, or is sufficiently hazardous by the volume of film piled up in projection head or sound head, the projectionist can leave the room and allow the fire to burn itself out.

If the automatic fire extinguisher is attached, to which reference is hereafter made, no serious fire can occur in the projection machine. I am convinced that if fire does occur there is no danger to the public, provided that the projectionist shuts off his machine and lowers the port shutters, as the fire cannot spread beyond any properly constructed room such as called for by the regulations. There is no evidence before me of any fire spreading beyond the projection room in any theatre where the projection room was built according to our regulations, nor do I see how it can. Moreover, there is little or no possibility of smoke or fumes escaping from the projection room into the body of the theatre. This can only escape through the port holes; and if the shutters are closed in case of fire this cannot occur. Moreover, the port holes are in most cases, if not in all, glassed in, and the ventilating system of the projection room is ordinarily sufficient to carry away the fumes and smoke if any fire does occur.

The only danger to the audience is alarm through recognizing a burning film as it appears on the screen before

the projection lamp is shut off and before the shutters are closed. The evidence before me would not indicate that this is a condition likely to arise. The only evidence of burning film appearing on the screen would be from a fire at the aperture. Such fires occur from time to time and are confined to the aperture: and there is no evidence that the audience has ever been disturbed in any way by it or know what it was. There is no evidence of any panic arising in this way.

A good deal of evidence has been submitted as to the duties of projectionists and the rather trying and exacting nature of the work which they are called upon to perform, and to which work. it is alleged, the closest attention must be paid at all times. I am not convinced that the work is so arduous and exacting as alleged. It might be well to observe in passing that the actual time a projectionist is employed is six hours per day . . .

If the film comes direct from the exchange it is supposed to have been already revised, but the evidence shows that generally the projectionist does not rely upon this revision but revises it himself. The evidence further shows that in some few cases the film as received from the exchange was not in a proper condition to run . . . Once the show is built up and the film has been revised, it is not thereafter necessary to revise the film to discover any defects during the time that this show is being run, unless it happens that the film is old and in somewhat poor condition, and subsequent revisions may be necessary to take care of any defects that may develop and which may become noticeable . . .

Time Element Held Important

In B.C. at present each projectionist attends to his own machine. When he has projected his picture and his machine is shut off and the other machine is turned on, he takes the film from the lower magazine, rewinds it, puts it back into the cabinet, takes the next film in sequence from the cabinet, places it in the upper magazine, threads up his machine, connecting the film with the reel in the lower magazine adjusts his carbon. cleans the aperture, dusts off his reflector, and does such other incidental things as may be necessary. All of these combined duties which he has to perform in the intervening period of 20 minutes while the other machine is in operation will probably take him 5 or 6 minutes . . .

The important duty of the projectionist is the operation of the machine itself, that is. the projection of the picture. The other duties are chiefly routine duties, important but neverthe-

less routine, and not requiring any great skill, mechanical knowledge or experience. The thread-up of the machine is not a difficult process although one that undoubtedly requires the exercise of considerable skill. The ordinary projectionist will probably spend two minutes in threading up his machine. This procedure, in my opinion, could be learned by the ordinary young man of average ability in the course of a few days. There is nothing technical about it. The same applies likewise to the duties of revising and rewinding the film and patching the film. These are ordinary routine duties, although important duties. The other duties which I would describe as routine duties, it appears to me, could be attended to and done smoothly and efficiently by one having only a few weeks' experience.

I saw this work done, including the projection of the picture, by two young men, one a boy of 16 years of age, each of whom only had a few hours of instruction, and they seemed to have little difficulty in doing the work. It is my opinion, therefore, that an apprentice could do this work equally as well as a licensed projectionist; and with the employment of an apprentice, the projectionist could be left to do those duties which call for his special qualifications, namely, the projection of the picture. The employment of an apprentice would not increase the hazard from fire, which is after all a very small hazard so far as the public or, for that matter, the projectionist, is concerned, because even if a fire does occur, it is impossible for such fire to escape from the room, if the projectionist on duty does those things which he is supposed to do under the circumstances.

As stated previously, I have had the advantage of visiting five theatres in Seattle. Only one projectionist is employed on a shift in Seattle. The same applies to the whole State of Washington. There is no regulation requiring the employment of more than one. This one projectionist operates the same amount of equipment as found in the best equipped projection room in Vancouver. He seemed to do so with little difficulty and quite efficiently, and was not so busy on the occasion of my visit that he could not find time to discuss with us his work and to explain the processes and give us any information we desired. He did not, I observed, stand by his machine to watch the projection of his picture. His other duties would not permit.

In these theatres the rewinding was done by the motor rewind and not by hand, and this lessened to some extent his routine duties. There was no separate rewind room in any of these theatres visited. In one theatre the projectionist, an inexperienced young man, told us he had "built up" his show that night for the first time in his experience. When one considers that in seven years only 19 theatre fires were had in the City of Seattle with one projectionist, and with approximately 50 theatres in operation, and that none of these fires were of a serious nature or had got beyond the projection room (except in one case where the projection room door was left open) and that no panic was caused on any occasion, it would seem that operating conditions, even with one man, cannot be described as in any degree hazardous from the standpoint of public safety. The working time of the projectionist here is likewise six hours.

Praises 'Automatic' Extinguisher

In none of the theatres visited by me in Seattle did they have an automatic fire extinguisher. I witnessed a demonstration of the Pyrene Fire Extinguisher. Four demonstrations in all were given. First, the film proposed to be projected was damaged by cutting away a strip on the side of the film so as to remove the sprocket holes and thereby cause the film to stop before the aperture and thus cause a fire. The machine was threaded and set in motion; a fire at the aperture took place, but as the aperture gate was closed the fire did not spread, and only about one frame of the film was burned, that is, about one inch. Second, the film was

allowed to pile up in the projection head; a fire broke out at the aperture, but did not spread; the gate being closed, the result was the same as before.

Third the projectionist left the piled up film in the projection head which had accumulated during the second demonstration. In addition, a film was placed in the upper magazine and threaded down loosely through the aperture, and the aperture gate was left open in order that the fire could spread to the projection head. The machine was set in motion, and the film, not moving through the aperture was ignited; the aperture gate not being closed, the fire extended to the projection head. Immediately the fire extinguisher operated, the insert gas was released from the cartridge, was projected into the upper magazine, the projection head, the sound head, and the lower magazine through four openings provided for that purpose, and the fire was immediately extinguished. The film was packed so tightly in the projection head that a considerable portion of it was burned, and the fumes escaped into the projection room. The fire did not spread to the upper magazine.

Fourth the projectionist simply took a quantity of film, rolled it up and put it into the projection head, and trailed it down over the aperture, left the aperture gate open, and started the projection machine. As the film was not moving at the aperture, the ensuing fire spread to the projection head, where the film was loosely piled. The extinguisher acted so quickly that the fire was put out before any great quantity of the film was burned.

I was much impressed with the practical effectiveness of the automatic fire extinguisher. Fire usually occurs only at the aperture. It may extend through to the projection head. If it does, the fire extinguisher acts automatically and the fire is extinguished in an instant, much more effectively than could be done by the projectionist with a hand machine or otherwise. Should the fire extend downward into the sound head or lower magazine, the operator has only to break the celluloid link or fastener directly in front of him, and the extinguisher operates immediately. I was advised by the demonstrator that this extinguisher could be easily installed on any standard projection machine. For extinguishing any fire occurring in any part of the machine, I am satisfied that this fire extinguisher is most effective. There may be others equally effective . . .

It is my opinion, therefore, that it is not contrary to the public interest to allow less than two licensed projectionists to operate à Kinematrograph under the conditions prescribed in Regulation 31.

Classification of Projectionists

The second matter referred to in this inquiry is:

"Into the question whether it is in the public interest to have more than one class of projectionist, in addition to apprentice projectionist licensed under the said Act and Regulations."

On this question I have had little direct evidence of any satisfactory nature to assist me. The chief reason advanced for the necessity of the two classes is that the men who have heretofore held second-class licenses cannot pass the first-class examinations. Prior to the adoption of the regulations in 1936, we had under the former regulations two classes of projectionists, the first and the second classes. The second-class man was restricted to work in theatres of 500 seats or less. Since the adoption of the regulations which provide for one class of projectionists only, the second-class men have been granted permits under which they are now operating. The equipment upon which the second-class man works is, generally speaking, the same as that on which the first class man works, and I am at a loss to understand why such a man should be considered incapable of using this same or similar equipment in a large theatre.

Many of the second-class men are employed in places where they operate two or three nights a week. This is not usually their only employment. The man holding a first-class certificate would not be interested in securing employment in such places. A number of the second-class men are employed regu-

larly in small theatres which operate daily. It appears, however, that as the regulations covering the examinations now provide, these second-class men could not pass the first-class examination. The standard may be unreasonably high. On that I express no opinion, as it does not, in my view, come within the scope of the inquiry. Certainly it appears to me that so long as that standard is maintained, it will be necessary to provide for a second-class license, and particularly for those small theatres not operating daily, and, perhaps, likewise for the small theatres operating daily, in some of which the owner himself is the operator, or where the expense of a first-class operator might be prohibitive or work an injustice upon the owner.

Continue Second-Class License

If these men now operating upon a permit cannot pass this first-class examination, and this would appear to be so with respect to many of them, then unless the permit is extended indefinitely, some provision must be made so that no hardship is worked upon these men and upon the public to whom they provide entertainment. I am quite satisfied that from the standpoint of public safety they are capable of projecting a show on the equipment on which they have been engaged, or similar equipment. The second-class license could be restricted to that equipment in the discretion of the examining Board. Under the circumstances it appears to me that, for the present at least, the second-class certificate should be continued.

It is my opinion, therefore, that it is in the public interest to have more than one class of projectionist in addition to apprentice projectionists licensed under the said Act and regulations.

Is Rewind Room Necessary?

The third matter referred to in this Inquiry is:—

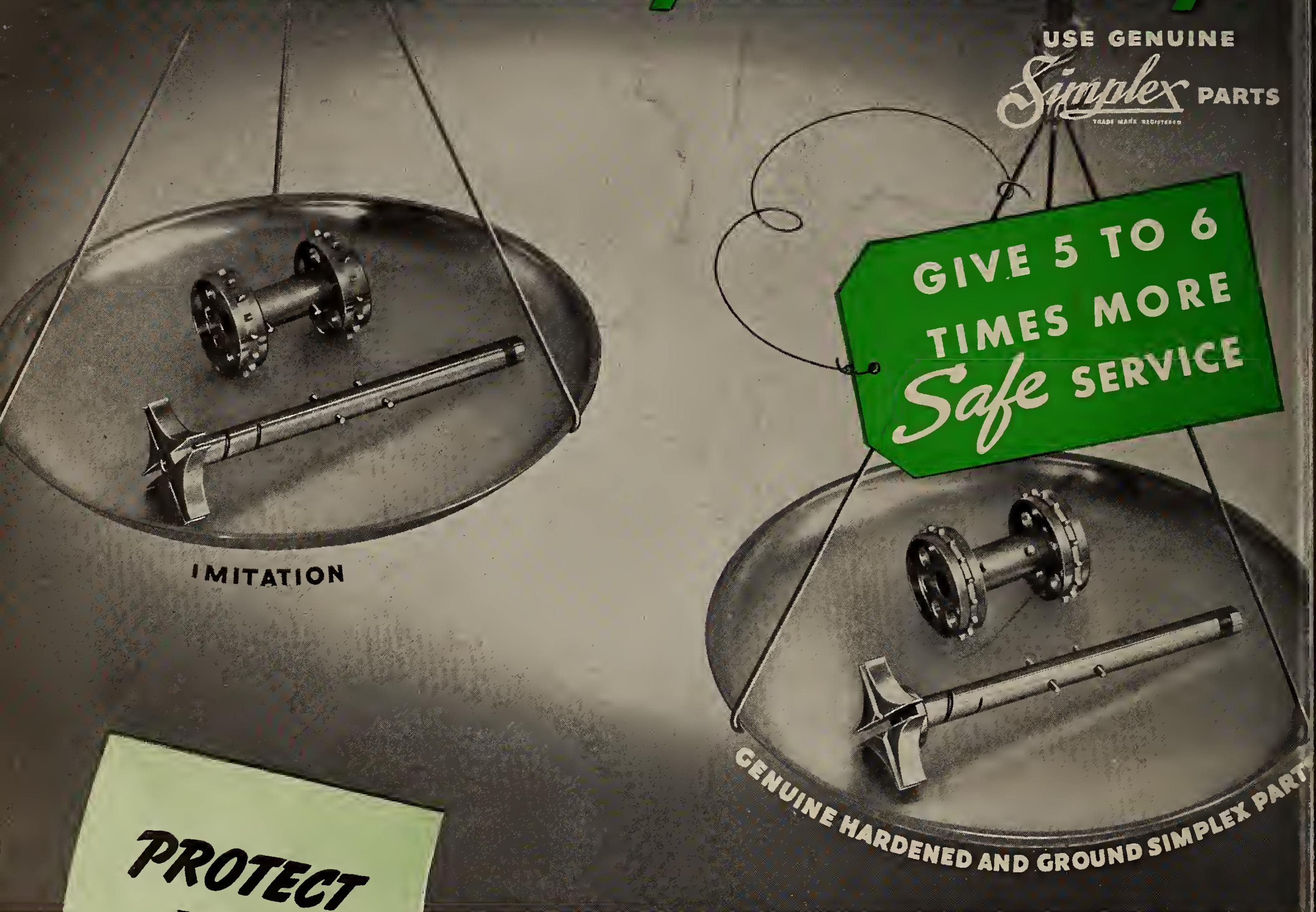
"Into the question whether it is in the public interest to allow a kinematograph to be operated in a moving picture theatre that has no rewind room."

The evidence before me shows that while a separate rewind room is advisable, it is not essentially necessary. It would be well to require that all theatres hereafter constructed should have, as a matter of further safety, a separate rewind room, but it does not appear to me to be at all necessary or justifiable in the interests of public safety to compel the present theatres to conform to such a standard. The danger is not great if the rewinding is done in the projection room . . .

The regulations at present provide adequately for the storage of film in cabinets of certain specified construction. They are so enclosed for the reason that if fire does take place it will not spread to these films and it should not with only three films exposed in the room, one in each machine and the other on the rewind bench, even if the whole three should burn, providing the cabinets were kept closed as required. The cabinets in some of the theatres do not seem to close as well as they should, and more frequent check-up is advisable. If a separate rewind room were in use, the possibility of the ignition of this stored film would be entirely eliminated, if the film were kept in properly constructed cabinets.

It is my opinion, therefore, that it is in the public interest to allow a kinematograph to be operated in a moving picture theatre that has no rewind room.

Get *More* for your Money!



PROTECT YOUR PATRONS

•

PROTECT YOUR POCKETBOOK

GENUINE HARDENED AND GROUND SIMPLEX SPROCKETS AND STAR WHEELS give five to six times more *safe* service than *ordinary* sprockets and star wheels!

Imitation parts may LOOK LIKE genuine Simplex parts...but don't be fooled! Only Genuine Simplex parts . . . made by the producers of the Simplex Projector itself . . . possess the matchless accuracy and the wear-resisting qualities which assure perfect projection and the maximum of safe service.

Guard against unsteady pictures and annoying breakdowns . . . use genuine Simplex parts *exclusively*. They cost so little that you can't afford to take a chance with imitations.

INTERNATIONAL PROJECTOR CORP.
88-96 Gold Street New York, N. Y.

DON'T TAKE A CHANCE . . . USE ONLY

GENUINE Simplex PARTS

TRADE MARK REG'D

DISTRIBUTED BY NATIONAL THEATRE SUPPLY COMPANY

Ip

International PROJECTIONIST

OCTOBER 1937 Vol. 12, No. 10

25c Copy

$2 a year

**ONE OF AMERICA'S LEADING THEATRES—
THE CINE IN CHICAGO—USES**

THE MAGIC VOICE OF THE SCREEN

Follow this Leader to Bigger Box-Offices!

You, too, can install this superior sound—no matter how small or large your theatre—at a price designed to meet your own requirements.

MAKE the sound in your theatre better! Better sound means better box-office—and you'll get better sound with RCA Photophone—the Magic Voice of the Screen!

Five leading motion picture companies in Hollywood use RCA Photophone apparatus for recordings. Thousands of theatres from coast to coast use RCA Photophone for the reproduction of finer sound on the screen. Big theatres and small.

Follow the example of the famous Cine Theatre—and other leaders. Give *your* screen this Magic Voice! There's a type to suit your theatre—at a price to suit your purse!

Made by world's leading sound organization

ONLY MAGIC VOICE OF THE SCREEN OFFERS THESE 10 PROOFS OF SUPERIORITY

Rotary Stabilizer
Cellular Speakers
Low Cost Maintenance, Liberal Service
Simple Operation
Economical Operation
Push-Pull Adaptability
High Fidelity Reproduction
Simple Installation
Accessibility
Sole Ownership

RCA *Photophone*

THE MAGIC VOICE OF THE SCREEN

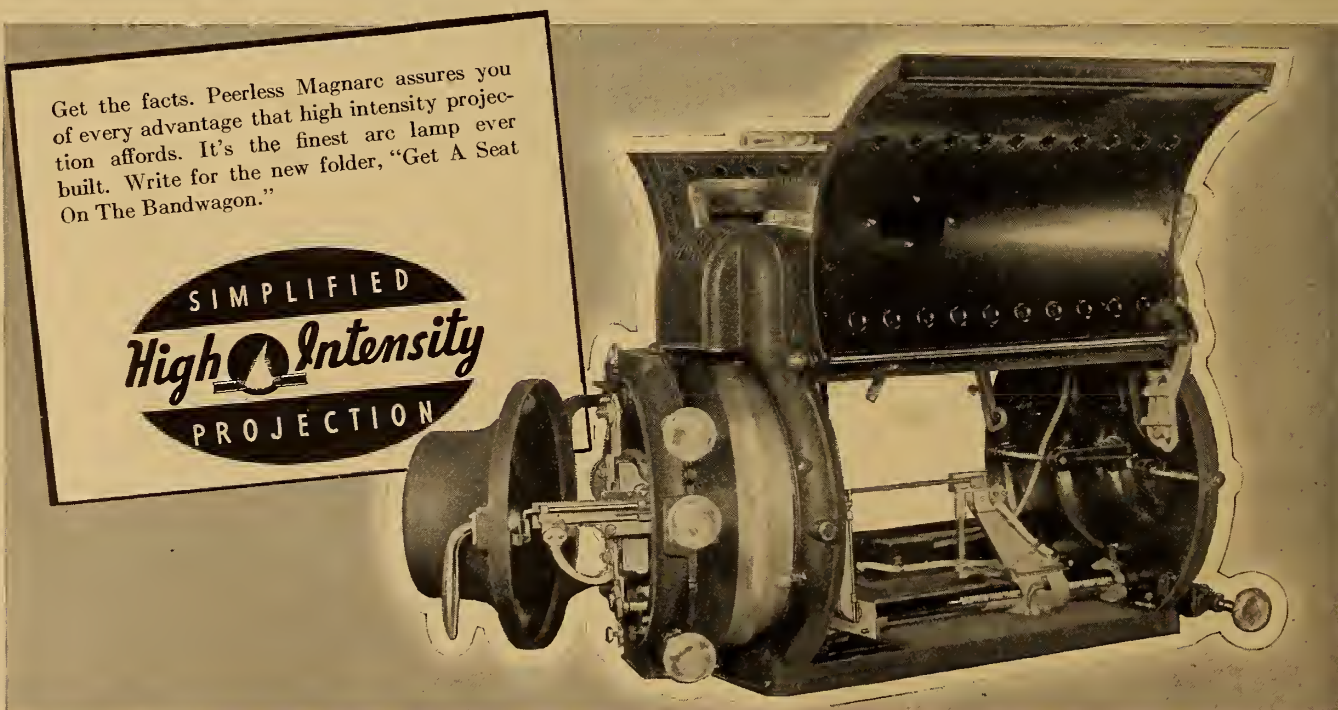
MAGIC VOICE of the SCREEN

RCA MANUFACTURING CO., INC., CAMDEN, N. J. • A SERVICE OF RADIO CORPORATION OF AMERICA

● Now that one theatre in every three has high intensity projection, every theatre owner without it faces a new situation. Theatres using high intensity have 75 per cent of the country's total seating capacity. They also are the theatres best attended and paying the most profitable return.

Obviously, if thousands of theatres have installed high intensity projection, high intensity projection cannot be expensive. Its really low cost will surprise you. Peerless Magnarc Lamps produce 200 to 300 per cent *more* light on the screen for the same current cost as low intensity.

You need high intensity projection not only to hold, but to increase your patronage.



Peerless MAGNARC

TRADE MARK REG.

MANUFACTURED BY

J. E. McAULEY MFG. CO., 552-554 W. ADAMS ST., CHICAGO

Sold by National Theatre Supply Co.

International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 12 OCTOBER 1937 *Number 10*

Published Monthly by

JAMES J. FINN PUBLISHING CORPORATION

580 FIFTH AVENUE, NEW YORK, N. Y.

Circulation Manager, RUTH ENTRACHT

SUBSCRIPTION REPRESENTATIVES

AUSTRALIA: McGills, 183 Elizabeth St., Melbourne
NEW ZEALAND: Te Aro Book Depot, Ltd., 64 Courtenay Place Wellington
ENGLAND AND DOMINIONS: Wm. Dawson & Sons, Ltd., Pilgrim St., London, E. C. 4.

YEARLY SUBSCRIPTION: United States and possessions, $2 (two years, $3); Canada and foreign countries, $2.50. Single copies, 25 cents. Changes of address should be submitted two weeks in advance of publication date to insure receipt of current issue. Entered as second-class matter February 8, 1932, at the Post Office at New York, N. Y. under the act of March 3, 1879.

INTERNATIONAL PROJECTIONIST is not responsible for personal opinions appearing in signed articles in its columns.

420

MONTHLY CHAT

REJECTION of the proposed new projector aperture by the S. M. P. E., for reasons which are perfectly obvious to every practical projectionist, seems to have amazed the West Coast studio people. The practical fellers, in turn, are amazed at some of the "explanations" advanced by the studio people in support of the proposal. All of which is grist for the I. P. mill, as evidenced elsewhere herein.

INCIDENTALLY, the turnout of practical projection men for the recent S.M.P.E. Convention in N. Y. City was the best ever, disproving anew the contentions of certain snooty observers that craft members are notoriously indifferent to technical advances and mindful only of more money for shorter hours. (We might add that all our boys paid their own transportation, hotel bills and keep, being unable to emulate the snooty technicians by handing in swindle sheets.)

THINGS are happening on projection developments behind the scenes. Rumblings reach us concerning new light sources, metal reflectors, reversed floor slope, three-dimensional pictures, new color systems involving radical changes in projection apparatus, maskless screens, and many other developments which render hazardous in the extreme any prediction as to what the projection process will be like ten years hence.

And yet there are those who having entered the craft twenty years ago have learned nothing since. Most of these fellows are worrying about television, the application of which to the theatre field appears extremely doubtful, the while they are unable to locate a blown tube.

THE way the sound reproducer business is now set up occasions wonder as to with whom the organized sound servicemen will bargain. Sound service seems definitely headed in the direction taken years ago by projector service, that is, service when needed and requested. More anon on this interesting speculation.

OUR 16 mm. information service program is pretty well lined up now—even though we disbelieve all these tall tales emanating from towns at the crossroads relative to 16 mm. being "just as good" as 35 mm. projection, and those taller tales from cities anent 16 mm. delivering "perfect" 20-foot pictures at throws exceeding 100 feet.

WE REPEAT: please notify I. P. of any change of address. A penny postcard, stating both old and new addresses, will do the trick. It helps so very much.

BUY Xmas Seals, the purchase of which has helped many within the craft in the past. Now it's your turn.

INTERNATIONAL PROJECTIONIST

VOLUME XII NUMBER 10

OCTOBER 1937

AN ANALYSIS OF IMPERFECTIONS APPARENT ON THE SCREEN

By *A. C. SCHROEDER*

MEMBER, PROJECTIONIST UNION 150, LOS ANGELES, CALIFORNIA

Here is a pertinent reminder of everyday screen defects of such common occurrence as to be almost taken for granted by projectionists, together with a summary of the more unusual troubles, past and present, which escape casual notice. Particularly interesting is the author's evaluation of the Suprex-type arc, especially with reference to quantity and quality of screen light and carbon length.—Editor.

SINCE sound pictures were introduced there has been little attention paid to visual projection. It behooves us, therefore, to consider methods for improving the screen image, to level a critical eye upon existing faults and to consider the reasons for them.

Suppose there is a hop in the picture, often called "jump," when the picture does not remain steady but moves up and down. Sometimes this movement is at a steady rate; sometimes it is irregular. The type of jump indicates the cause. The regular up-and-down movement usually is due to some defect in the intermittent mechanism, including the intermittent shaft, the sprocket, and *dirt on the sprocket.* Ordinarily this will cause the picture to hop four times during every foot of the film.

Older projectionists remember that these troubles usually occurred on Saturday nights, when the machines were speeded up excessively to get the break sooner and "dump the house." At the increased speed the picture might start to jump, due to insufficient tension on the shoes to stop the film at the same position each time. The result was an irregular up-and-down movement as to both rate and amount—some being barely perceptible, while others seemed likely to hit the ceiling. Loose tension shoes also cause a jump at normal speeds. Here is one blessing of sound pictures: the speed is now practically uniform, and we no longer see a man racing across the screen when he should be walking. Some "shooting galleries" still run film above normal speed, but the increase is not so much. Years ago the accepted projection speed was 60 feet per minute, but on many Saturday nights I ran them at 120, and cranking the machine at that. Film speed now is 90 per minute, and rarely do the "joints" run them faster than 95. So little time is gained thereby as to render the practice valueless. In fact, it means poor sound reproduction, but that is a minor consideration to many managers.

Causes of Picture Jump

Picture jump may also be due to numerous other troubles: worn parts in the movement, or in the tracks or tension shoes; the film trap may not close completely, due to sticking or foreign objects in the way; tension shoes cocked or sticking (yes, it has happened); loops that are too short, defective sprocket holes in the film, poorly made splices, and sometimes the hop is in the film itself, a rarity nowadays. Another rarity is a shaky booth, although I have seen some in which the picture moved when the projectionist ("operator" then) walked across the room.

Worn sprocket teeth and short loops are doubly bad, since they ruin not only the performance but also the sprocket holes on the film, so that when the film is run on a good projector, and with loops of the proper size, picture jump

will be occasioned by the damaged holes.

Side motion is usually caused by the lateral guide rollers at the top of the film trap being adjusted too loosely. Another possibility on the older Simplex is where the small shoe at the top of the film trap door comes loose and the top end of it swings out, touching the guide roller and holding it away from the film. The rickety machine also causes this type of trouble.

Now, how about screen light? With the profusion of new lamps the light situation should be about settled. But is it? The writer thinks not. True, bills for current have been cut substantially, but the carbon bill has not dropped much. It seems to me that the price of Suprex carbons is inordinately high, because the quantity of carbon (cubic inches) consumed with this lamp is very much less than we used with the old rotating-type, high-intensity lamps. It may be more difficult to make these new carbons, materials may cost more, and then there is the cost of new machinery and of development which the consumer must absorb ultimately. But why have the positive carbons been made just this length? Apparently, at this length the stubs will be the most numerous; or should I say, longest? We could easily use a positive several inches longer; in fact, a positive 20 inches long will work nicely in our lamps. Possibly there are reasons why this cannot be done. I would be intensely interested to hear these reasons. A German manufacturer has brought out a 9 mm. positive 20 inches long.

Turning to the theatre again, I don't know whether the light has been improved or not, generally speaking. In many theatres the light has been improved by Suprex lamps, but in most cases the light is definitely not good. By this is meant not the quantity but the quality of light. We use 8 mm. carbons and have no trouble getting a clear field over the entire screen. However, with the 7 mm. carbon the crater is quite a bit smaller, and it seems next to impossible to clear up the corners and still maintain good light.

I, personally, have had no experience with the 7 mm. set-up, so I don't know what can be done with it; but from what I see in other theatres it appears impossible to effect improvement, even where they have very good projectionists. If my deductions are correct, poor screen illumination is not the fault of the crew.

The carbon problem apparently has not yet been solved. With some carbons the light seems to "come and go." The light flares up, becomes extremely bright; a few seconds later it becomes very dim. A few more seconds and it is bright again. This may continue for six or seven minutes. We have not had so much of this lately, but occasionally we experience it. Then, some carbons sputter and spit for three or four minutes after being lighted. Baking the carbons in the lamp helps some, as does splitting the coating along the side; but with some carbons neither nor both of these measures do any good, and the carbon goes merrily on spitting. Of course, this shows up as a flicker on the screen.

I may seem to be harsh and condemnatory of the Suprex-type lamp and the carbons, but with all their faults, the crew in our theatre like the particular set-up we have now *much* better than the old high-intensity lamps.

In many smaller houses the illumination still is on the low side, and flickering and discolored light is often seen. Most of this, I presume, is due to antiquated equipment, the balance probably being due to carelessness. But how about prints so dark that one cannot force any light through? Here is where sound hits us in a vital spot. The perforated screen is robbing us of oodles of light, and it is not helping sound, either, because there must be a few db. attenuation as the sound goes through the screen.

Sound Screens, Extraneous Light

Many of our screens are not cleaned often enough. It is surprising how much light is lost with a dirty screen. Another problem is the screen that is improperly cleaned, with blotches all over it and bright areas here and dark ones there. Seams and torn places are an eyesore, as are also indentations made by objects thrown at the screen by small boys, or dirty spots made in the same way. Screen wrinkles are unforgivable in projection work.

Extraneous light reaching the screen detracts considerably from the screen image, having somewhat the effect of the illumination being reduced. Although the total light on the screen is greater, the contrast between the light and the dark objects is reduced, thus making the picture more indistinct that it would be otherwise. Extraneous light may come either from the house lights directly, or, more commonly, may be reflected from some light-colored surface onto the screen. Frequently this light is of reddish hue, which is certainly not conducive to eye-comfort.

Focus is a never-ending projection problem. We all know the shortcomings of film from certain studios. When the film itself is so blurry that it looks like a wool blanket, it is useless to try to wiggle the lens back and forth in an effort to improve it. Given a good print, when there is trouble with sharp focus we again encounter the problem of worn parts at the gate and at the film trap. If the film cannot be kept in the same plane, or if the film is curved instead of flat, it is impossible to keep the picture focused.

Previously we mentioned loose guide rollers in connection with side motion. Here again we have trouble from these rollers, but this time it is because they are adjusted too snugly, causing the film to buckle and throwing either the center or the edges of the picture out of focus. After a compromise lens position is found, the film will probably buckle in the other direction and will be out a mile. We try again and wait for the next buckle. Frequently this occurs so rapidly that the effect approximates flutter. The picture flutters back and forth like a flag in a breeze, precluding any possibility of obtaining a satisfactory screen image.

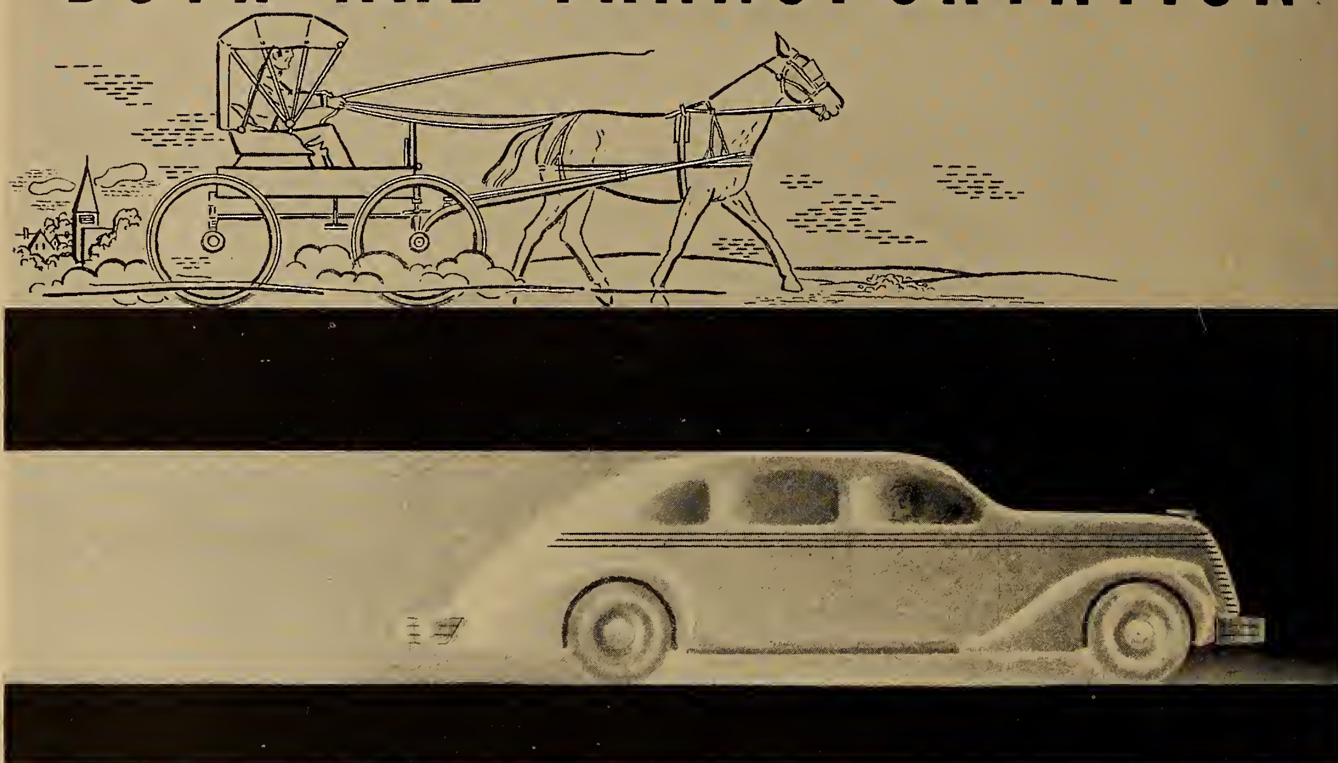
Buckling is often due to the condition of the film itself. When the film dries out it changes shape, so to speak, the edges and the center part of the film are no longer the same length, so that the edges will be more or less flat in a lengthwise direction, and the center will have a series of humps all along the entire length. Such a film will be buckled as it passes the aperture, and parts of the picture will be out of focus. This condition also causes the film to snap from one extreme to the other.

Of interest in this connection is our experience with Grandeur film some years back. This film was 70 mm. wide, twice the present standard. Naturally, such film was more prone to buckle than was the narrow film. To overcome this tendency to buckle, the front plate and the film trap door on the Grandeur machines were a sort of angular affair. The part above the aperture sloped toward the lens at an angle of from 15 to 20 degrees from the vertical (with the machine on the level, so that it would be at the same height as the center of the screen). The part at the aperture and a small space *immediately* above and below it was vertical. Just below this was another angle, the plate and film trap door sloping away from the lens, also at from 15 to 20 degrees. This caused the film to be bent at an angle, both above and below the aperture, and it was then almost impossible for it to also bend at another angle in a direction across the aperture, thus effectively eliminating any tendency toward buckling.

These conditions (buckling and focus) are aggravated when using lenses of short focal length. With a lens of 5 or 6 inches in focus there is little trouble; but with a lens of from 2½ to 3½ inches, life is just one terrible focus after another.

I nearly forgot projection angles. Boy, is this another nightmare! All that can

BOTH ARE TRANSPORTATION



BUT WHAT A DIFFERENCE

In comparison with modern SIMPLIFIED HIGH INTENSITY projection old style low intensity projection is as out-of-date as the horse and buggy. And as uneconomical.

The picture on the screen is all you have to sell. Clear, snappy black and white and good accurate color pictures can only be projected properly with high intensity light, such as audiences are accustomed to in the big theaters.

SIMPLIFIED HIGH INTENSITY projection is no longer a luxury. Almost any house can afford it. And every house can make it a business builder.

SIMPLIFIED—

1-SIMPLIFIED LAMP MECHANISM 2-FEWER LAMP PARTS

3-LOWER ARC CURRENT

Two to three times as much light on the screen as you get from low intensity, costs so little more than you are now paying, that one extra admission per show will cover it.

Write for the new, free, illustrated book — "The Eternal Triangle In Picture Projection."

SIMPLIFIED
High Intensity
PROJECTION
WITH "NATIONAL" "SUPREX" CARBONS

ECONOMICAL AND MODERN

NATIONAL CARBON COMPANY, INC.
Unit of Union Carbide and Carbon Corporation
CARBON SALES DIVISION, CLEVELAND, OHIO
General Offices: 30 East 42nd Street, New York, N. Y.
BRANCH SALES OFFICES: NEW YORK PITTSBURGH CHICAGO SAN FRANCISCO

be done is to focus the center of the picture and let it go at that. Here, too, the short-focus lenses have the worst of it. Some of the boys stop down the lens, which helps the focus; but what can they do then to get some light on the screen—especially on those 22- and 24-foot screens? We tried stopping down, but had to remove the stops again in order to get some brilliance on the screen. We have tried lenses that gave us a better focus, but again the light was poor; and with other lenses the conditions were reversed.

Regarding focus, we should mention the colors seen on the screen due to chromatic aberration. I have not seen this condition for years, but possibly it still exists in some places. This is due to a faulty lens, about which projectionists can do little. Experienced projectionists can tell quickly when there is a drop of oil on the lens. It looks funny on the screen and I cannot describe it exactly. The remedy is obvious, but its "sure-thing" application is difficult. Keeping the machine immaculate helps, but there still will be occasional traces of oil on the rear surface on the lens.

An invisible accumulation of dirt and smudge forms on the lens. The picture looks alright, yet when the lens is cleaned the picture is sharper, proving the presence of a film on the lens. This occurs also on the inner surfaces, but not so fast. The lens should be taken apart and thoroughly cleaned more frequently than is the custom. When should this be done? The projectionist should not do this on his own time; yet most managers will not pay for the extra time required. This problem exists with practically all projection equipment. Before the show about all a man can do is clean the lamphouse and the mirror, test for sound, play a record and thread a projector. Then the boss comes around to see if there is a drop of oil on the machine!

Effect of Projection Angles

Returning to projection angles, which occasion considerable distortion, characters are lengthened to an extent depending upon the degree of angle. This makes the characters look thin. When the seats close to the screen and off to the side are occupied it aggravates the trouble, making the screen people look like beanpoles. Vertical parallel objects are no longer parallel, but are wider at the bottom than at the top; and if the object happens to be near the edge of the picture, it is no longer vertical either, the lower part being further from the center-line of the screen than the upper portion.

(TO BE CONTINUED)

A UNIQUE METHOD FOR ALIGNING CARBON ARC LAMPHOUSES

By *JACK K. LEATHERMAN*

MEMBER, PROJECTIONIST UNION 511, JACKSONVILLE, FLORIDA

LAMPHOUSE alignment, if done properly, requires a very accurate system. To align the optical axis of a horizontal arc with that of the projection lens I use the principle of the surveyor's telescope. The gadget used is a brass cylinder with cross-hairs in each end (Fig. 1). To use, it is clamped in the lens holder of the projector, and by sighting through the front end the center of the positive carbon is brought into alignment with the centers of both cross-hairs simultaneously. When this is done the lamp is in perfect line both horizontally and vertically with the lens.

Remember that when sighting the carbon end, only the end must be seen; if its length is observed, the lamp must be adjusted until it is concealed behind the circumference of the end.

Procedure on Assembling

For those interested in making a "centering barrel," a few pointers might be helpful. The barrel is six inches long and the same diameter of your projection lens. The brass tube should be from stock not less than 1/16 inch, to insure rigidity. When buying the tube have the dealer saw both ends off square, which precaution costs no more and avoids considerable trouble.

After smoothing the ends of the tube, lay out the circumference of one end into quarters. Use a knife edge to mark these divisions. Extend the quarter division marks back on the barrel ¼ inch, and at the end of each mark drill small holes to accommodate hair wires. When you have finished drilling one end you should have four holes 90° apart.

We must now drop a perpendicular line from one of the holes to the bottom of the tube. Place the tube (holes upward) on an absolutely level table so that one hole slightly overhangs the table. Through this hole fasten a thread and allow it to hang down past the tube. At the lower end of the thread attach a small plumb-bob. Using the thread as a guide, inscribe a mark for the lower hole on the barrel. Use this mark as a starting point to lay off this end of the tube in quarters, and drill as you did before. When finished, the holes of both ends should be perpendicular to each other.

Now to string the hair wires through the holes so as to form a cross at each end of the barrel. The wires should be No. 38 copper; wire from a discarded radio-frequency choke will suffice. Draw the wires tight and apply a little solder in each hole. Remove surplus solder so that the tube will not bind in the lens holder. When both sets of "cross-hairs" are in place, you are ready to check the tube for accuracy.

Preparing, Using the Target

On a sheet of paper draw a circle "target" 8 inches in diameter and divide same into quarters. Mount the barrel horizontally in a small vise and attach to a chair or stool. Tack the target on a wall level with the centering barrel. Sighting through the barrel, line-up the cross-hairs with target quarter marks, and get the target circle to just fit the inner circle of the barrel.

If these conditions are fulfilled simultaneously. the gadget is ready to check your lamphouses.

Should a more accurate instrument be desired, I would suggest taking an old lens barrel to an optical repair shop and have them mount the cross-hairs. Optical glass might be placed in both ends to protect the cross-hairs from possible damage. An estimate for such a job in this locality was five dollars.

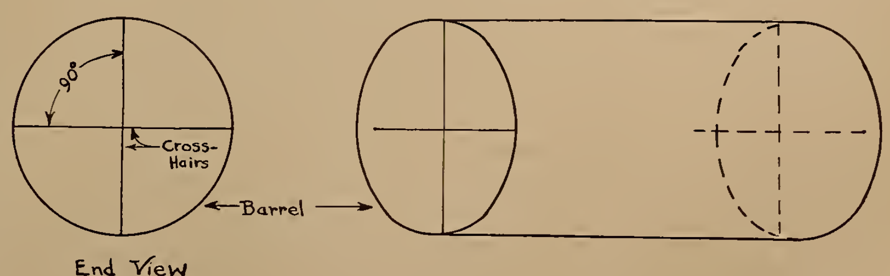


FIGURE 1

There may be some readers of I. P. who can suggest either an extension or alteration of this process. Let's hear about it.

S.M.P.E. PROJECTION GROUP REJECTS ACADEMY INCREASED APERTURE PLAN

Appended hereto is the report of the Projection Practice Committee of the S. M. P. E. on the proposal of the Research Council of the Academy of M. P. Arts & Sciences to increase the size of the present projector aperture. Approved by Committee members to a man, this report was presented to the recent S. M. P. E. Convention, which voted unanimously to sustain the Committee in its findings.

Following this action by the Society, the Academy issued a statement relative to the aperture question, which release is also appended. The divergence of opinion between these two groups is discussed in detail on the editorial page.

IN VIEW of the fact that essential action photographed upon the film is often cut off from the screen during the process of projection, the Projection Practice Committee of the S.M.P.E. recommended last May that cameramen draw upon the ground-glasses of their view-finding devices, hair-line rectangles that could be used as guides or danger signals in composing their scenes. Specifically, the proposal was to inscribe upon the ground-glass a hair-line rectangle 0.815 x 0.590 inch, which would be slightly within the dimensions of the standard projector aperture, which are 0.825 x 0.600 inch.

To avoid misunderstanding, it should be emphasized that this would make no change in the photographic area of the film, but would act only as a warning to the cameramen that the heads or feet of their actors are approaching the points at which their images would not be projected upon the screen in the theatre. By adopting dimensions slightly smaller than the existing projector aperture dimensions, allowance was made for screen masking, film weave in the projector, keystone effect, *etc.*

Rejects Academy Proposal

On September 16 last the Academy of M. P. Arts and Sciences issued a memorandum dealing with proposed revisions of the dimensions of the standard projector aperture, the stated purpose being to decrease the possibilities of cutting off the images of the heads and feet of actors from the screen. Among other alleged advantages were superior pictorial composition of the scene during production, and the facilitating of composite and process shots, *etc.* Specifically, the proposal was that the dimensions of the projector aperture be *increased* to 0.615 x 0.846 inch, and that the projector aperture be moved laterally so that its center-line would coincide with the center-line of the camera aperture.

The Projection Practice Committee is unable to concur in the Academy's proposal for several reasons:

(a) *Film Shrinkage and Weave.* At the time the present dimensions of the projector aperture (0.825 x 0.600 inch) were established, careful consideration was given to the extent of shrinkage and weaving of the film, and it was felt that the dimensions arrived at represented a limit that did not leave much margin of safety with respect to framing the picture in the aperture. The combined effect of shrinkage and weaving during film travel, occurring throughout the photographic, processing, and projection processes, *even at present* may lead to a danger of non-framing of the picture by the projector aperture. Before any attempt is made to encroach upon the small margin of safety now remaining, careful consideration should first be given to the maximum lateral film shrinkage and weave, and present and past releases should be checked to determine how closely the studios and laboratories are maintaining present-day standards.

Everyday experience shows that there is great variation in the lateral displacements of the picture on the film as well as of the sound-track. Under these circumstances the adoption of the Academy proposal would often permit the lateral frame line of the camera aperture to appear upon the right-hand side of the screen, and in extreme cases even the images of the sprocket-holes might appear in the picture.

In the present standard a difference of 0.0065 inch is allowed between the center-lines of the camera and projector apertures, this allowance being made to compensate in some measure for film shrinkage, and to prevent the appearance of the camera aperture edge upon the screen. The difference was allowed in one direction in view of the fact that the shrinkage occurring subsequently to photographing is regarded as always in the same direction, namely, toward the guided edge of the film, (which is the fixed datum). Such allowance is not included in the Academy proposal, in view of the fact that the camera aperture and projector aperture center-lines are made to coincide.

It may be contended that shrinkage by itself may not be sufficient cause for concern; but combined with weaving and other inaccuracies occurring during the many processes through which the film must pass, the combination of all these effects is likely to result unfortunately. Cognizance should also be taken of the considerable variation that occurs not only in general release prints, but particularly with respect to title apertures in domestic releases, and foreign apertures in general, particularly in news shots.

Small Increase in Area

(b) *Photographic Composition.* The claim was made that by increasing the projector aperture 21 mils in the horizontal dimension, and 15 mils in the vertical dimension, opportunity would be afforded the cameraman to compose his scenes more artistically and dramatically. Simple calculation shows that increasing the dimensions of the present standard projector aperture to the proposed values will result in an increase of area of projected aperture of only five per cent. In linear dimensions, this would mean an addition to a 20 x 15-foot screen picture of only three inches on each side, and 2¼ inches at top and bottom.

It is exceedingly doubtful whether such small increase in linear dimensions would add appreciably to the dramatic delineation, particularly when the industry at various times has seriously considered widths of film up to 50 and even 70 mms. as necessary for adequate improvement of dramatic scope. In view of the 50 or 100 per cent enlargement of scope required, therefore, the 2½ per cent proposed increase is obviously negligible. It is just as obvious that appropriation of even the few thousandths of an inch still remaining for safety during projection would never in any reasonable sense achieve the photographic improvement sought for, up to the limit of the 35 mm. film.

Furthermore, the fact must be taken into account that the effect of the picture upon the spectator is a function not only of the size of the picture upon the screen but also the distance of the

viewer from the screen. Considering the average viewing distance found in theatres, it is felt that the effect of a 2½-per cent increase in the dimensions of the screen picture will be negligible. The angle subtended by a 20-foot, 6-inch screen at the eye of a spectator seated fifty feet from the screen would be exactly the same as if the spectator were viewing a 20-foot screen 1¼ feet nearer.

Sympathetic to Large Area

Although the foregoing remarks have been specifically connected with screen images, it is obvious that they apply equally well to studio sets and camera images. The Projection Practice Committee is sympathetic toward any attempt to improve photographic composition, scope of scenes, size of aperture plates, *etc.*, that would result in any real advantage: but it is the Committee's feeling that the change, to be justifiable, would have to be entirely more substantial than is possible in existing mechanisms.

In the case of the Academy's proposed specifications, it is the Committee's feeling that any advantage resulting therefrom will be negligible, and the difficulties attending the introduction thereof into existing practice would be very serious, as outlined in other sections of this report.

(c) *Screens and Masking.* It is obvious that any enlargement of the projector aperture will produce an enlargement of the screen image, and that consequently the screen will have to be remasked. Moving the masking is in itself a fairly expensive job; but, in addition, it should be borne in mind that the screens in thousands of theatres throughout the country are by no means new. Many of them are quite dirty and discolored, and moving the masking will leave a white border around the edges of the dirty and faded portion. A two- or three-inch white strip around the edge of a 20-foot screen would be bad enough in the case of black-and-white projection, but it is obvious that the situation would be still more unfortunate when color-pictures are projected. This means, then, that either the screen must be cleaned or otherwise renovated, or a new screen must be purchased.

Great Cost For Little Gain

(d) *Cost.* It is extremely difficult to estimate exactly what the cost would be to effect a change from the present standard to the proposed dimensions. However, a fair idea may be gained by remembering that there are approximately 16,000 theatres in the United States that would be forced to buy new apertures, shift the screen masking, and probably be required either to renovate their screens or buy new screens. It is estimated that the change could not be effected even in small theatres for less than $50, and may amount to as much as several hundreds of dollars when necessary to purchase new screens.

It is probably not too much to anticipate that the cost to the exhibitors of the country would approximate $1,000,000. In addition, it is obvious that all theatres could not make the change at the same time. Many theatres are in financial difficulties, and many of those that are not may not find it convenient to make the necessary expenditure. Accordingly, introduction of the proposed aperture would extend over a considerable period of time during which much confusion and many poorly projected pictures would result.

Partial Change Impossible

In the case of those theatres that could not afford to make a complete change immediately, they could, of course, install the proposed aperture; but in that case the picture would spill over upon the masking. If they persisted in using the present standard aperture, while the cinematographers were taking advantage of the enlarged photographic area by allowing their actors to approach closer to the limits of the ground-glass in their view-finder, such theatres would be cutting off more of the heads and feet than ever before.

The Committee is unanimously opposed to the Academy proposal for the reasons given above. The American Projection Society also concurs in this action of the Committee. Furthermore, the proposed aperture would not accomplish the objective of the original S.M.P.E. proposal last Spring, namely, to provide the cinematographers with a hair-line as a danger signal, within the area enclosed by which they should keep their action. Even were a larger aperture accepted, such a danger signal would still be necessary.

The Society's proposal remains the simplest, speediest, and least expensive method of avoiding edge-of-frame cut-off on the screen. On the other hand, the Academy's proposal is a major, extended, and costly matter.

Accordingly, the Projection Practice Committee hereby reaffirms its original proposal and strongly urges its general adoption.

Director Slaps Projectionists On Aperture Rejection

THE *Hollywood Reporter* provided the one humorous interlude in an otherwise serious and rational technical discussion when it published a wire dispatched by Edward H. Griffith, described as a "well-known" and "progressive" motion picture director, to the S. M. P. E. Convention then in session in N. Y. City.

Typically Hollywoodian as to style, length and ignorance of the problem at hand, Griffith's wire, as culled from the *Reporter*, is appended hereto:

GENTLEMEN READ WITH CONSIDERATION YOUR STATEMENT REGARDING CHANGE APERTURE SIZE TODAY'S REPORTER STOP HAVING BEEN ACTIVELY ENGAGED DIRECTING MOTION PICTURES FOR SOME YEARS AND CLOSE TO HOLLYWOOD PICTURE FEEL YOUR DISCUSSION RELATIVE APERTURE CHANGE COMPARABLE TO TAIL WAGGING THE DOG STOP CANNOT UNDERSTAND WHY PROJECTIONISTS SHOULD BE ALLOWED RETARD IMPORTANT BUSINESS EITHER TECHNICALLY OR FROM FINANCIAL ANGLE STOP YEARS AGO PEOPLE OPPOSED CONSTRUCTING BROOKLYN BRIDGE BECAUSE OF EXPENSE AND TAXES STATING FERRIES PLENTY ADEQUATE STOP HOWEVER THAT ADVANCEMENT WORKED OUT BENEFICIALLY AS HAVE OTHERS SINCE STOP BY PROPOSED REDUCING APERTURE SMPE PUTTING PICTURES BACK SEVERAL YEARS BECAUSE OF EXPENSE TO THEATERS STOP YEARS AGO MOTION PICTURE HISTORY MADE BY D W GRIFFITH IN INTRODUCING CLOSEUP FOR EMPHASIS STOP HE BELIEVED AND IT HOLDS IF AN AUDIENCE IS TO UNDERSTAND QUICKLY IT MUST SEE ITS SUBJECT QUICKLY STOP DECREASING APERTURE HOWEVER SLIGHT DEFINITELY REMOVES THOUGHT FURTHER AWAY FROM AUDIENCE AND IS STEP BACKWARD STOP SPEAKING FROM EXPERIENCE IN MOTION PICTURE FIELD THERE ARE ONLY TWO ANSWERS TO YOUR DISCUSSION STOP EITHER KEEP ABREAST OF ADVANCEMENT AND SPEND MONEY IN THEATRES TO ENLARGE APERTURE GIVING PATRONS MORE ADVANTAGEOUS SCOPE OR LEAVE WELL ENOUGH ALONE BUT DO NOT ADVISE A STEP WHICH FORCES THE INDUSTRY TO RETROGRESS HOWEVER SLIGHTLY DEPRIVING PATRONS EVEN TO THE SMALLEST DEGREE STOP SINCERELY

EDWARD H GRIFFITH

That ought to hold you projectionists of twenty-five years' or more experience who try to tell a Hollywood director about theatre projection. How dare you harass an ARTIST by considerations of film shrinkage and weave, projection angles, exhibition costs and sundry other matters too, too mundane to merit attention by the inhabitants of the Citadel of Culture?

Academy Reply to S.M.P.E. Recommendation

REGARDING the divergence of technical opinion between the Academy and the S. M. P. E., Major Nathan Levinson, vice-chairman of the Academy Research Council, stated that the latter's original proposal of September 16, 1937, ... was distributed throughout the industry in an effort to obtain a coordination of technical opinion on the present aperture dimensions and the advisability of a revision . . . . at this time.

"This memorandum," said Levinson, "did not 'recommend' an increase in the dimensions of the standard aperture, but merely 'proposed' a revision in the dimensions of the aperture for the purpose of obtaining the viewpoint of all technical authorities in the industry on the matter. . . Whether or not any re-

visions are adopted by the industry is of little moment at this time; but the Council is fulfilling its primary function in this matter, as in all others with which we are concerned, in acting as a clearing house for the industry in carefully investigating all matters in connection with any technical change in advance of making that change.

Not 'Selling' An Aperture

"The Council is not 'selling' an aperture either larger or smaller than the present aperture, but is only concerned with getting the best possible aperture for use in the industry. Stories in the press have been brought to our attention carrying figures purported to indicate the costs to the theatres of revision . . . These indicated costs, in my opinion, have been grossly exaggerated.

"In addition, the revision proposed by the Council, is approved by all concerned and eventually adopted by the industry, is very flexible and will be optional with any theatre. Those theatres which may not wish to expend the small amount of money necessary to purchase and install aperture plates of the new dimensions and alter their screen masking, may continue as at present; but those theatres which may wish to take advantage of the new improvement may do so at a small cost by installing new plates and remasking as their screens are cleaned or renewed.

"Our Committee . . . will continue its consideration of the matter . . . Upon the conclusion of consideration of all technical opinions submitted by representatives of studios, equipment companies, commercial laboratories, theatre circuits and other technical organizations, including of course the S.M.P.E., the Committee will submit their findings to the Council . . .

"If approved by the Council, these recommendations will then be transmitted for action by the proper authorities concerned with a change in equipment such as is involved in this case."

• *Letters to the Editor* •

Insists That Aperture Heat Influences Manpower

It is not my intention to prolong the discussion of aperture heat. The matter will not be mentioned again. I feel an urge, however, to defend the presumption that the subject has *some* bearing on manpower.

My only contact with the industry outside this remote locality is through I. P., God bless it. Naturally, I. P. forms my opinion on many questions, including impressions of what factors are important to projection men throughout the country.

From time to time you have mentioned, with obvious satisfaction, certain legislation making two-men shifts a requirement. I conclude that, regardless of the feeling that there is good reason for voluntary return to two-men shifts, the projectionist fraternity approves of such legislation and would welcome more of it. It occurs to me that the consideration back of these laws must be safety. The lawmakers' only object, I presume, is to reduce the possibility of exposing the public to any fire hazard.

If that assumption be correct, the course of action to get more legislation is to call attention to the risk, however slight it seems to us who are familiar with it.

K. P. Kenworthy
Moscow, Idaho.

Larger Suprex Carbons Now Available, Says Noris Co.

Your comments in the "Monthly Chat" column are always read by us with a great deal of interest. There is one paragraph in the September "Chat" about which we have some comments to make. The paragraph states: "No larger Suprex carbon combination will be forthcoming soon, at least not within the next year." This is emphatically not so.

As long ago as September, 1935, we brought samples of larger Suprex carbons into the United States at the request of one of the larger lamp manufacturers. The positives were 8 mm., 9 mm., and 10 mm. in diameter and were 16 inches long. The negatives were 6 mm., 7 mm., and 8 mm. in diameter, respectively, and 9 inches long. These trims functioned perfectly as far as light and burning time were concerned, giving approximately 12% to 15% more light than a standard 8 mm. Suprex trim, at an increase in current of from 5 to 10 amperes over the usual 65. The only factor to be perfected at that time was straightness of the positives.

The extent to which these larger Suprex carbons of ours have been improved since that time is best illustrated by the fact that we are now supplying 9 mm. by 20-inch Suprex positives together with 7 mm. x 9″ negatives. These carbons are giving an excellent account of themselves in this country, and for the past six months have been in daily use with great success. We will be glad to show you samples of this trim.

The salient features of this 9 mm. x 20″ Pos., and the 7 mm. x 9″ Neg. Suprex trim probably will be interesting. This combination is rated at 75 to 80 amperes, but can be boosted without any trouble as high as 100 amperes, in which case the light intensity comes within reach of the light produced by 13.6 mm. carbons, using 125 amperes. Of course, if the maximum of 100 amperes is used, the carbon consumption increases considerably, although it still cannot be called "prohibitive."

If, however, this trim is burned at its normal rated amperage, it will give an increase in light of about 17% to 20% over that produced by a standard 8 mm. positive 7 mm. negative Suprex combination. Conclusive tests have furthermore shown that the ratio of carbon consumption is approximately 1:2.5 in comparison with a 12″ positive carbon. This favorable ratio is achieved first, by the construction of the carbon itself, and second, through the elimination of carbon waste (stubs) due to the extra, added length of eight inches. Since the price of the 9 mm. x 20″ Suprex positive carbons is by no means excessive, and since the carbon shows such decided advantages in operation, this trim can under no circumstances be called an oddity or an experiment.

The point we wish to emphasize is that a larger Suprex trim *is* practical; that a larger Suprex trim *is* on the market and has been for quite some time.

Noris Carbon Company
E. W. Schumacher, Manager

The information relative to Suprex carbons which appeared in last month's Monthly Chat, and referred to in the foregoing letter from Noris Carbon Co., was obtained from and *credited to* National Carbon Co. This data was published as the well-considered opinion of a reputable company, with the same measure of good faith that prompted publication of the Noris letter. We view the situation as one wherein National having spoken for itself, Noris now speaks for itself—the procedure in both instances serving to emphasize anew the established policy of I. P. to open its columns to anybody and everybody having something interesting to say anent the projection process. Honest differences of opinion, particularly where company policy is concerned, naturally do not involve any question of veracity.—Ed.

FILM PERFORATING PROCESS

Perforating the film would be comparatively simple if it were not for the extreme accuracy required. The punches and dies are so accurately made that the punches can not be inserted into the dies by hand without injuring them, although when clamped in the machines they go in and out thousands of times without appreciable wear. Each punch consists of eight punching members and eight positioning members, or pilots, four of each on each side of the film.

As the film passes through under the punch, four pairs of holes are made. A shuttle then moves the film four spaces forward, and the ram moves down again. This time the pilots, which have slightly tapered ends, enter the holes that have previously been punched, and finally position the film before the punches strike the new holes, so that each set of eight holes is accurately positioned by the previously punched set of holes. The tolerance ordinarily used in manufacturing the punches and dies is approximately 0.00002 inch.

An Old Reliable Friend—

THE MOTOR-GENERATOR SET

By *L. P. WORK*

MEMBER, PROJECTIONIST UNION 601, CLINTON, IOWA

THE d.c. generator still is a reliable old horse. It is generally out of sight and out of mind—which usually means in neglect in a wet basement or furnace room filled with coal and ash dust. Yet it keeps on functioning for years, yes for decades, with nothing more than a commutator-dressing job or two and a new set of brushes when the old ones can't be set up any more. We have learned more about a.c. in recent years than we ever knew about d.c., even when the generator was the only electrical apparatus in the projection setup.

Since the advent of sound, it takes a lot of nerve to start a discussion about generators and good d.c., and since the "advent" of rectifiers—well, a discussion of the model T Ford would be just as timely. But even with the recent expansion in the use of rectification for many diverse purposes—such as polyphase mercury arc in electric railway practice, the Thyratron converter for high-voltage a.c. and d.c., the copper-oxide contact rectifier, and lately the magnesium and copper sulphide unit in projection practice—our old friend in the basement keeps on rolling along. It might be well to get acquainted again.

Theory of Induction

To have a good conception of what is going on in even the simplest shunt generator we should review a few facts about electric induction and its relation to the problem at hand. The basic inductive mechanism of all machines is outlined in Fig. 1 which shows the two pole pieces N and S of a permanent magnet, the single turn coil which is terminated in the two-bar commutator, and the brushes B1 and B2 which draw the current off the commutator. A magnetic field exists between the poles of the magnet in the space in which the coil is to revolve, and the strength of this field is described as lines of force per square inch of cross-sectional area.

In accordance with Fleming's rule for direction of current, an E.M.F. is induced in the revolving loop as it cuts the lines of force of the field, this action being quantitatively expressed in the formula:

$$\text{Output Volts} = \frac{P}{P'} \times \frac{RPM}{60} \times Cf \times 10^{-2}$$

which is the basic equation in the design.

The author using a modern oscilloscope testing outfit

In this formula P is the number of poles, P′ the number of armature circuits in parallel (not wires paralleled in the individual coil, but with respect to the whole winding); C is the total number of armature conductors and f is the flux per pole in megalines. Much can be learned by an inspection of the factors in the formula, *viz.*: the voltage is proportional to the flux per pole, the speed of the machine, and the number of armature conductors in series.

Obviously, the actual current induced in the loop is a.c. and not d.c., as the relation of any and all parts of the loop to the lines of force are reversed every half revolution. In multipolar machines this takes place in 180 electrical degrees and not in a half revolution of the armature, as in the simple illustration. If we were to bring out the current from the loop through two individual slip rings instead of a commutator, as shown, we would have an alternator delivering a.c., the frequency of which would equal the rpm of the loop, the root mean square voltage conforming to the aforementioned equation. It is but a step from this point to consideration of the plain shunt generator.

The Shunt Machine

The arrangement of Fig. 1 may be made to furnish its own field magnetism by passing part of the brush current through windings on each pole in shunt connection with respect to the armature and brush circuit. On starting, the slight residual magnetism present in the machine will furnish some current, which in turn builds up the magnetism in the fields until normal voltage and stability is reached. Practical commercial design dictates the general form as shown in Fig. 2, with four field poles and four brush positions in a machine with a lap-wound armature. The single turn coil of Fig. 1 is amplified to an armature winding having many coils, each with the necessary number of turns to produce the desired output voltage.

The air "core" of the single loop is of poor magnetic quality and is replaced by a laminated iron core of high permeability, thus carrying many more lines of force to be cut by the coils in their travel. The field coils are made up of numerous turns of fine wire so as to provide the necessary ampere-turns and magnetization of the field poles with a low expenditure of shunt current and minimum heating, as this is a direct function of I^2. The field coils are given more ampere-turns than necessary for proper magnetization at the voltage supplied by the machine, which allows the insertion of a variable resistance in series with the field circuit for a means of voltage regulation. Inasmuch as the output delivered by the armature at a given speed is proportional to the time-rate in cutting the lines of force by the armature conductors, any variation in the total number of lines present, such as produced by a change in the magnetic strength of the field poles, will give the same net result and vary the output voltage.

A representative load characteristic curve for shunt generators is given in

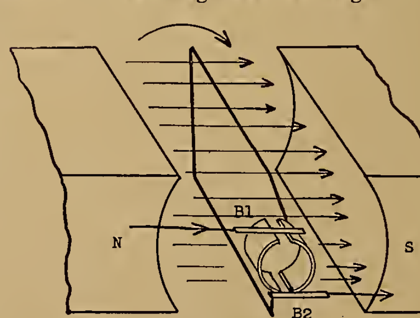


FIGURE 1

Figure 3, curve B, with a constant speed and a fixed setting of the field rheostat. As the amperage increases through an

increase in the connected load, such as the second lamp, the available voltage to magnetize the field also drops, producing a cumulative effect until a point is reached at X where the machine becomes unstable and the amperage slopes back toward the zero line. This effect is further aggravated by the increasing armature reaction, which will be considered later. This inherent weakness in the plain shunt machine may be overcome by the use of a series winding on the field poles to supplement the action of the shunt coils.

By providing a few turns of heavy copper (it must be heavy enough to carry the full load current of the machine) on each pole, and connecting these coils in series with the armature, we can automatically supply added magnetization which will increase with the load and, by proper design, can be made to hold the output voltage essentially flat. A machine so wound is called a compound generator, this type being universally used at present. The volt-ampere characteristic of such a machine is given in Fig. 3, curve A, which over the operating portion is practically flat giving the same voltage at the two load points of 25 and 50 amperes.

Attaining Good Commutation

Commutation is a separate subject an understanding of which requires considerable study. In modern design the factors affecting good commutation are of prime importance. The old shunt generator could not have perfect comutation for a number of reasons, some of these being: field distortion with load, shifting of the neutral zone with load, and the change in the neutral zone caused by varied field rheostat settings. The load current in passing through the armature coils produces a magnetic effect which is called armature reaction. This reaction tends to neutralize and distort the field flux, the distorting factor pulling the flux beyond the field pole *s* in the direction of rotation as if it were elastic (for the generator, in the d.c. motor it is against the rotation).

If the brushes are to be kept in the true neutral zone, they should be shifted to accommodate this magnetic phenomena, which obviously changes with load variations. In this connection it must be borne in mind that the coils are actually generating a.c., and that the brushes must "switch" each coil in and out of the circuit at the period of zero current which occurs at the instant of its *net zero flux.* We state it this way because there is present the complex effect of the old flux approaching zero, the new flux starting to build, and the reluctance of the coil to the change due to its own reactance.

The fixation of this neutral point can be had, and the effect of the armature in dragging the field flux nullified, by providing another set of poles properly energized and mounted midway between the field poles. These are called commutating or interpoles. They carry a few

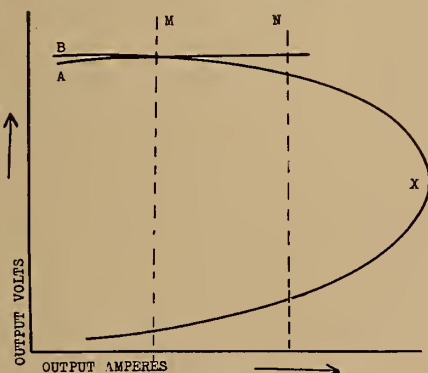


FIGURE 3

turns of heavy wire and are connected in series with the armature and the series field coils. They assist the coil undergoing commutation by providing an opposing field which compels a quick change of polarity as it passes the face of the pole.

FIGURE 2

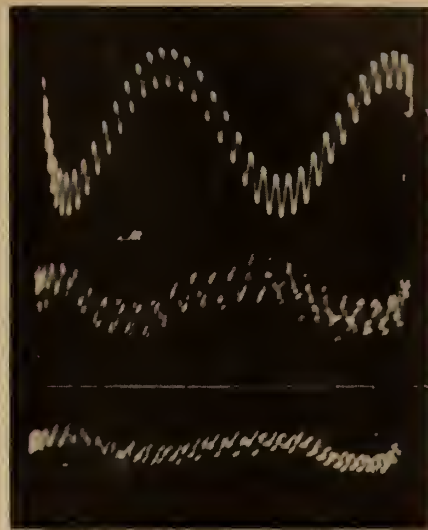


FIGURE 4

Figure 3 shows the location of the interpoles, which are narrow-faced to limit their effect to the coil under the brush. Thus, with the use of the series or compound winding and the addition of the commutating pole, the shunt generator having a drooping characteristic and tendency to sparking is improved to provide a flat-load curved with sparkless commutation at a fixed brush position.

An interesting study of a generator output is given in Fig. 4, which is an oscillograph of the ripple voltage from an old machine in need of a commutator turning job. The top curve is of the ripple voltage with no load at normal excitation, the machine being compound with interpoles. The large swing is the result of the overall eccentricity of the commutator; while the smaller high frequency is the actual ripple produced as the brushes change the a.c. produced in the armature to d.c. for the external circuit. With the load of one low-intensity lamp the machine gave the curve of Fig. 4B, wherein the eccentric voltage is greatly reduced, but the ripple remained the same at about ½ volt as read on a rectifier meter with the d.c. blocked out. In the bottom curve, 4C, the commutator had been machined and the ripple voltage reduced to one-half its former value.

Late design machines have improved greatly on the performance of the earlier compound generators. The plain sleeve bearing has been replaced with ball bearings; the commutators and armatures have more bars and slots which reduce ripple to the vanishing point; the balance of armatures is tested and corrected with much more precision; the whole machine is much smaller and quieter in operation; new insulating mediums have made the windings more impervious to oil and heat; the operating efficiency has been raised with a corresponding saving in power, and, lastly, the dependability is of the highest order.

Second in value only to the depend-

ability is the great smoothing power of the motor generator set on a.c. line variations, which are present in every theatre supply voltage. Fig. 5 proves this statement graphically. Here, per cent variation in motor supply volts has been plotted against per cent variation in generator output volts, with the stubbornness of the generator in "holding its own" well illustrated. By way of contrast. the dotted line M-N gives the slope that would represent equal per cent change, which still might be tolerable in view of the smoothing effect on transient changes which rotor inertia would have. Efficiencies on late machines run in the order of 65 to 70 per cent from motor input to generator output.

Too much stress can hardly be placed on the desirability and advantage of locating the motor generator set out of the basement and close to the projection room. Modern sets are very quiet and need only a reasonably resilient mounting to overcome transmitted noise; while

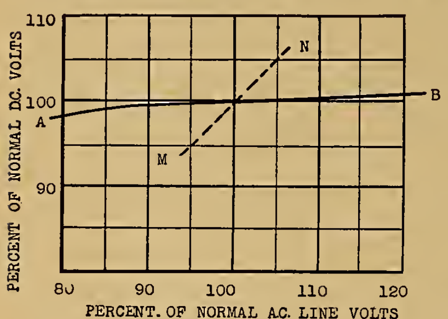


FIGURE 5

most theatre wall construction will satisfactorily insulate noises within the room provided there are no vents connected with the auditorium. Resilient mountings of various types and materials may be used, such as a good grade of soft cork, a coil spring arrangement, or rubber.

The National Electrical Mfg. Assoc. (NEMA), is working out standards of vibration and balance, using blocks of soft rubber. These blocks should be of a section that the weight of the unit will compress the blocks not more than 1/3 or ½ their original thickness. In any event, the set should not be bolted down after being placed on the resilient base, as this will almost cancel the effect of the special mounting.

Since the beginning of d.c. arc lamp projection the generator has been the least thought of and the most neglected of all the equipment involved in putting the picture on the screen, despite its extreme importance in maintaining the continuity of the show. There are examples of generators operating for twenty or twenty-five years and still in daily use. The writer knows of no other unit of projection equipment that could give such service.

MORE DATA ON THE W. E. MIRROPHONIC SPEAKER SYSTEM

By *R. C. MINER*

MEMBER, TECHNICAL STAFF, BELL TELEPHONE LABORATORIES

A SOUND picture reproducting system which gives aural effects approaching the clearness of a visual image in a perfect mirror has been introduced last year under the name of Mirrophonic Sound. One of the outstanding features of this new system is the loudspeakers, named Diphonic because all sounds below 300 cycles per second are fed into one unit while those above 300 are carried by another. This distribution is accomplished by a crossover network.

FIGURE 1

The Diphonic speaker comprises two units: one for all sound below 300 cycles, and the other for all sound above that frequency

The high-frequency speakers, of which either one or two may be used, are attached to a horn as shown in Figure 2. Both horn and speaker are commercial adaptations of those used in demonstrating the transmission and reproduction of symphonic music in auditory perspective between Philadelphia and Washington in 1934. The horn consists of fifteen individual cells, each of which tapers exponentially from five-eighths inch square at the small end to eight inches square at the flared opening. The cells are brought so close together at the small end that only a knife edge separates them, and at the large end they are arranged as compactly as the geometry of the arrangement permits. This multicellular construction makes the horn nondirectional.

A horn which has only a single air passage distributes sound uniformly over a wide angle at low frequencies, but concentrates the sound on the axis of the horn as the frequency increases. This condition is undesirable in a theatre since those sitting on or near the axis will hear too great a proportion of high frequencies compared with the low ones, while the reverse will be true for those sitting at the sides. In a multi-cellular horn of good design the various cells radiate sound of all frequencies and distribute it uniformly over a wide angle, thus giving a correct proportioning of all frequencies for all parts of a theatre.

The walls of the individual cells of the horn consist of two metal sheets with an intervening layer of felt, all fastened to-

(*Continued on page* 22)

FIGURE 2

The high-frequency speaker has a multi-cellular horn to distribute sound uniformly throughout the theatre

The **IP** EDITORIAL PAGE

Vol. 12, No. 10 OCTOBER 1937

The Proposed New Larger Aperture

No experienced projectionist, after examining the original Academy proposal to increase the size of the projector aperture, and after reading the report thereon by the Projection Practice Committee of the S. M. P. E., will have any doubts as to the worth of this project. Devastating is the accurate descriptive term to apply to the S. M. P. E. report; and the Academy rejoinder, we think, serves only to emphasize anew the utter futility of any such procedure. The Academy erred badly in handling this matter—in its technical calculations and in procedure. The technical errors apparent in the Academy statements are so glaring as to be almost unbelievable.

The original Academy proposal states that theatres may take the new aperture or leave it, as they choose. This is nonsense, of course; because if the photographed area be made larger, and a theatre elect not to adopt the larger aperture, even more of the image would be cut off top and bottom and on the sides of the screen than was lost with the old aperture. This is elementary projection stuff. Next, the Academy disputes the accuracy of the cost estimates on making the change. Well, the change would cost $125 in each of six Broadway theatres we could name offhand (remasking being a long job at high labor rates); and even a small-town theatre couldn't possibly do the same job, at prevailing labor rates, for much under $35. A little multiplication will show that cost estimates of $1,000,000 expense covering 16,000 theatres in America alone are not "exaggerated".

The Academy states further that it is not trying to "sell" a new aperture, that its original proposal was in the nature of a "recommendation," with competent opinion having been solicited. Well, competent opinion was forthcoming—but the Academy proves by its second press release, which disputes vigorously the findings of competent technicians, that it didn't like it, that it wanted an O. K., a Hollywood "Yes".

Academy procedure was a bit spotty, to say the least. The deal was that when the Academy got ready to shoot with the new aperture it would contact the S.M.P.E. and get an opinion. It didn't. It simply rolled the pill and then shot it to every industry paper. Some gullible editors swallowed the pill whole. I. P. didn't. But I. P.'s opinion published last month, was available in advance anytime anybody asked for it. This goes for the S.M.P.E., too.

Hollywood, no less now than in 1931, evidences a complete inability to understand the rather rudimentary principles of projection angles. It always thinks in terms of the level projection used in studio review rooms.

The latest Academy release states that the project will be pushed, despite the barrage of unfavorable opinion leveled against it. In due time, they say, the matter will be submitted to the "proper parties". Maybe the Academy would like to know that neither Loew's Theatres nor the Paramount chain want any part of a new aperture. In fact, these companies will resist strenuously its attempted introduction. And it isn't the cost of the change that prompted this decision.

Everybody concerned would like to go along with the Academy on the proposition of a larger picture. No argument here. But more important to the exhibition field, which after all provides the dough for the existence of Hollywood, is that some provision be made to prevent the cutting off at the top and bottom and sides of the theatre screen of the heads and feet of characters, and the loss of vital action. If the industry wants a larger picture, which means a larger aperture, we say let them have it. But, whether the present or a new aperture be used, the fundamental technical principle remains unchanged—that is, protection for the theatres by having the cameraman compose his picture within *safe projection limits*. This is all that anybody wants, all that the S.M.P.E. asked for originally.

Since the industry wants no part of a new aperture, the matter reverts to its former status. Hollywood is making pictures for exhibition in theatres. The theatres want to show these pictures in acceptable fashion. There can be only one answer to this situation: give the theatres what they want, the need for which is particularly acute.

Nonsense Out of Vancouver

Special Commissioner J. M. Coady, after a hearing, reports to the British Columbia Government that one licensed and one apprentice projectionist is an acceptable substitute for an experienced two-men crew. I. P. published this report last month. Even a casual reading shows that the Coady decision goes directly against the evidence adduced—but let's see how he got that way. He says "B. C. regulations are *standard*" (italics ours). We ask: how long will they remain so with apprentices on the job? The Commissioner's reverential attitude toward the National Research Council (Canada) and the S.M.P.E. is touching—when it suited his purpose. At other times he rejected the "standing" of these bodies. Why? Because the S.M.P.E. is definitely on record in favor of two-men crews! Who in the world, except Coady, questions the authority of the S.M.P.E., the official standardizing body on motion pictures throughout the world?

Coady flatly refused recognition of I. P. as a reference source, stating that it was a Union organ. Still, I. P. is cited by leading technical journals and scientific societies throughout the world. Coady says that sound-on-disc required two licensed men; but not so with sound-on-film. His summary cites Seattle, a one-man town, as ample evidence of the need for only one man, forgetting that previously he said that "operation" was the important duty and the position of a man at the side of the operating projector the vital thing! Can Seattle meet his requirements?

The Commissioner says the ignition time of film stationary before a lighted arc is 2 or 3 seconds. He's wrong; it's a fraction of a second. He cites improved film stock as lessening danger from fire. We ask: how has nitrocellulose film been so improved? He says film does not explode. Every fire authority extant asserts, and vigorously, that it does. He assumes perfection of film and equipment. Does B. C. forbid mutilated prints and worn equipment? He says there is no evidence of panic resulting from image of burning film on the screen. Doesn't he read the newspapers? He mentions "only 6-hour shifts." Is this why so many projectionists suffer

bitter torture for years by reason of pulmonary ailments? The Commissioner states that once the show is built-up, no further inspection or revision is necessary. He's wrong; film should be inspected after each showing. He states: work between reels totals only 5 minutes, while the double reel runs 20. Certainly; but what about a man being at the projector during these 5 minutes? While okaying apprentice boys, he alibis his approval of present classifications by citing the difficult B. C. examinations for license. Yet, his apprentice boys couldn't pass any classification! Pointing to Seattle, Coady cites motor rewinds "and only 19 fires in 7 years" there. Doesn't he know that motor rewinds are disapproved by every authority in the industry? Of course, what are 3 fires a year to the Commissioner—as long as he isn't there. He approves "automatic extinguishers." I. P. strongly disapproves such contraptions. So does every other competent observer. These gadgets are unreliable in operation, a definite hindrance to the projection process, and give off noxious fumes that are a menace to health. The Commission disapproves separate rewind rooms. Every projection authority recommends such rooms.

What is Commissioner Coady's score at this point? Answer: zero. We challenge the Commissioner to disprove any of the aforementioned statements. On the basis of the evidence adduced at the hearing, the Coady report is nonsensical in the extreme and utterly unworthy of an impartial body.

The W. E. Mirrophonic Speaker System

(*Continued from page* 20)

gether by a heat-softening cement. This makes a wall with very high damping to mechanical vibration and effectively prevents horn rattles. Assembly of the sixty similar walls into cells and of the fifteen cells and other parts into the completed horn is accomplished entirely by soldering.

The high-frequency speaker is shown in cross-section in Figure 3. The moving element consists of a diaphragm made of thin aluminum alloy to which is attached a cylindrical coil of many turns of aluminum ribbon wound on edge and held together by thin layers of varnish between adjacent turns.

To deliver the required amount of sound energy to the horn, the diameter of the diaphragm has to be considerably greater than the wave-length of the highest frequencies which it reproduces. If the diaphragm were coupled directly to the throat of a horn, the output at the higher frequencies would be greatly decreased because the phase of the sound coming from various parts of the diaphragm would differ. To eliminate these differences sound is taken from the diaphragm through several concentric annular passages so that the distance from any portion of the diaphragm to one of the passages is small compared with the wave-length of any sound transmitted.

The magnetic field for the air-gap of the high-frequency speaker is provided by a field coil wound for 24 volts, the voltage which is generally used with theatre equipment. Safety features such as a cover over the field terminals and various factors for convenience in installation and ruggedness which have been built into this speaker contribute materially to its satisfactory operation in the field.

The low-frequency speaker of the Diphonic system is also an improvement over those used previously in theatres. The driving element consists of four dynamic speakers of the cone type connected in a vertical row to a shallow cavity which flares out to a flat baffle. An approximately square post is mounted in the cavity directly in front of the speaker units so that the surfaces of the post form angles of about forty-five degrees with the plane of the baffle. Two thin vertical vanes are mounted in the cavity between the post and the sides of the cavity to aid in the proper distribution of the higher frequencies ıadiated by the loud speaker.

The construction of the parts which form the cavity and baffle is so rugged that it prevents the possibility of extraneous sound being radiated by mechanical vibration. The advantages of this loudspeaker are good distribution of its higher frequencies, improved efficiency, and elimination of resonance effects which tend to distort the quality of the sound by unnaturally prolonging certain tones.

The entire loudspeaker can be installed easily and dismantled quickly if required. It occupies a minimum of space on the stage and has small depth—an important consideration because some of the older theatres have very shallow stages. With its greater capacity for sound volume and improved distribution of all frequencies over the entire theatre the Diphonic loudspeaker is a notable improvement in sound equipment.

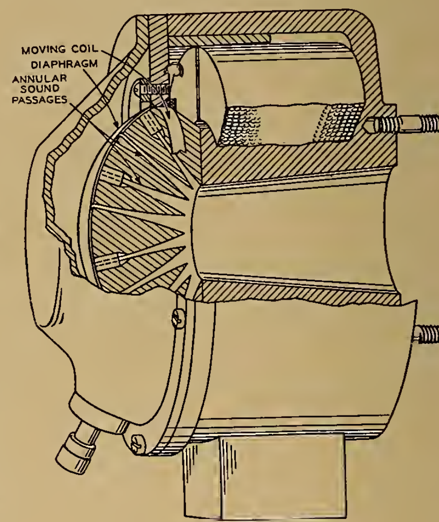


FIGURE 3

Sound radiated by the diaphragm of the h. f. units is conducted through annular passages to prevent interference effects

EXECUTIVE PROMOTIONS AT INTERNATIONAL PROJECTOR CORP.

Herbert Griffin (center) vice-president, announced promotion of A. E. Meyer (right) to General Sales Manager. Meyer, who served as Export Manager for many years, is succeeded by John Brozek (left).

TYPICAL TROUBLES IN MODERN SOUND REPRODUCING UNITS

By *LEROY CHADBOURNE*

V.

THIS month's grist of sound equipment troubles includes one that defied every effort at projection room repair. The complaint was poor quality, very poor, just at the start of a new run of an exceptionally promising picture. The routine check-up was made and showed no obvious defects: exciter lamps were in focus, all meters read properly, all speakers were functioning. The manager's distress increased as the picture ran its course with dramatic musical sequences sounding like burlesques of the original, and the star soprano qualifying for amateur night. When the picture ended the manager's distress prevented notice that the newsreel sounded quite good in spots, and that the short wasn't bad at all.

The projection crew, confined to a small and noisy room, with no better guide than a monitor speaker, also failed to notice these things or at least to give them proper consideration. They were, furthermore, very busy trying to change amplifier tubes in the course of an extremely short intermission. The new tubes brought no improvement either to the sound or to the manager's state of mind.

Change of a photo-cell had just been completed when a member of the relief crew arrived thus permitting one of the crew to step out into the theatre and check the sound personally. Change-over was from the old cell and the comedy, to the new cell and the first reel of the feature, and it appeared as if the new cell had made things worse. However, the same man had an opportunity to hear the feature on the old cell also before his shift ended, and on leaving the theatre he told the manager emphatically that the fault must lie in the recording.

The manager had heard the picture before, and knew better. However, he called the exchange, and was assured that there were no bad prints, the studio having taken particular pains. In fact, they had gone so far as to make two different types of prints, A. and B, for different types of reproducing equipment. No effort had been overlooked, said the exchange.

The projectionist waited to hear the result of this phone call, and then let his dinner go altogether. He insisted that the print must be the wrong one for his type of equipment. It took an hour's argument and a demonstration of the relatively good quality of the newsreel and the short to put the idea over. The B print was secured (they had been running A)—and the sound was wonderful!

High Fader Setting

A somewhat similar case concerned a difficulty centered in the projection room, although complicated by print trouble. The complaint was noisy sound, and was first reported midway through the afternoon. The management was asked to cooperate by checking as to whether both projectors were equally noisy and also to compare two shows and note whether the same noises reappeared in the same scenes. The result of the latter check left no doubt that the film itself was noisy, but as the evening advanced and the theatre filled up complaints from below became more urgent. Volume had to be raised to an unusual point to compensate for the increased attendance. The recording was not only noisy, but exceptionally weak. The high setting of the volume control brought out background noises that ordinarily were never heard, and perhaps created others through the unaccustomed strain of maximum amplification.

Since the picture had several days to run, overhaul of the sound system was considered advisable. In the course of a night's work all tubes and photocells were tested for noise by process of temporary replacement, and one cell and several tubes were discarded. A somewhat worn exciter socket was also discarded. Arc feed motors were grounded through condensers, and the water-pipe ground of the sound system was cleaned and tightened. These precautions proved insufficient. Socket prongs and volume control contacts were cleaned with a pencil eraser, the holding bolts of a power transformer were tightened, and change-over switch contacts cleaned with Carbona. All soldered connections accessible to inspection were looked over, and a few that seemed suspicious were redressed.

At this point in the proceedings the system itself seemed satisfactorily quiet, and sound from one projector was wholly satisfactory, but a slight, unusual noise, hard to identify, still was heard in the other. Close inspection showed that the pin of the take-up belt was the defect. Squeezing down the ends of that pin with a pair of pliers finished the job.

Carelessness in jumping to conclusions prolonged another case of trouble-shooting through half a day, when the difficulty should have been corrected in less than an hour. In a very new system, thoroughly equipped with modern low-frequency and high - frequency speakers, the sound suddenly went "sour." Volume had dropped off to the point where extreme volume setting was needed and was not quite enough. Quality also was distinctly bad. The condition developed during the pre-show test, and remained the same with all film.

Careless Trouble-Shooting

There was no question that the poor quality was caused by absence of the normal component of low frequencies, and that the same condition (since the lows carry a great part of the total body of the sound) was responsible for the decrease in volume. The beautiful new multiple—speaker system was in everyone's mind, and it was taken for granted that something had gone wrong with the l.f. speakers or their circuits. This assumption seemed so obvious that no effort was made to check it, and the speakers in question were investigated with great enthusiasm—but with no helpful results.

A voltmeter applied backstage showed that the field supply was normal in every way, but the ear revealed that they were certainly not delivering their usual volume of sound. Voice coil connections were investigated and proved okay, and the search was extended to the filter network where frequencies are divided and allocated to their respective speaker units. All connections there seemed perfect, but the idea that the network must have gone haywire persisted. The theatre was at the point of sending for a new network when a random application of headphones indicated that the quality of sound entering the filter was just as poor as the final product heard in the theatre.

This finding was confirmed by application of the phones to the output of the voltage amplifier, and double-checked by more careful attention to the monitor sound, which last was conclusive in that particular system. The fascinating hypothesis of trouble in the multiple-speaker system was abandoned, and the voltage amplifier investigated more carefully. A brief physical check-up showed

poor contact to the grid of the second amplifying tube. The trouble was cured with a soldering iron. After normal operation had been fully restored everyone concerned realized that taking time out to turn on the monitor, and to compare its output very carefully with the output of the stage speakers, would have prevented several hours of poor sound and useless effort.

The Trouble That Couldn't Exist

The amplifier shown in Fig. 1 was responsible for two nights of trouble-shooting. The delay in this case arose out of trusting implicity to the manufacturer's wiring diagram, which proved to contain an extremely slight mistake.

Fig. 1, incidentally, is *not* a wiring diagram, but a circuit or schematic drawing, which merely shows the electrical relationships of the component parts. Suppose, however, that inspection of Fig. 1 makes it desirable to trace some particular wire, say the line that runs upward from resistor R-5 to the plate of V-1. The resistor, R-5, can be identified more easily in a wiring diagram than in the actual amplifier. The wiring drawing will further show the exact course and location of the wire in question, whereas in the physical apparatus that wire is hidden behind other parts and is much more difficult to follow. If it should be desired to apply a test to that wire, the wiring drawing will show at just what point it is most easily accessible, and the amplifier is approached at that convenient point.

The trouble in this case was an irregular, rumbling noise. The system was modernized Wide Range, not a new system, but one that had been greatly improved by changes, including installation of a multiple-speaker system. The amplifier shown in Fig. 1 is the photo-cell amplifier, not new, but, as will be seen, modernized for wider frequency range.

The rumbling, unsteady noise was traced to No. 1 projector, and after replacement of the photo-cell and similar easy operations, was transferred to No. 2 projector by interchange of the p.e.c. amplifiers. This proved definitely that the amplifier itself was responsible, and that the trouble would have to be run down in its internal wiring.

A quick review of the circuit of Fig. 1 should prove helpful to an understanding of the trouble-shooting procedure. There is no internal power supply. Plate power is admitted through the "+90V." terminal at the bottom of the drawing, and may be traced up and right through spring suspension No. 2 and through the primary of T-1 to the plate of V-2. From the filament of V-2 down and left to the filament of V-1, down through the bias resistor R-3, and through spring suspension No. 1 to ground, which is the common negative. From a point just above spring suspension No. 2 a branch line runs left, and up through R-9 and R-1 to polarize the photo-cell, the cathode of which returns to ground. From this branch another line runs upward through R-5 to the plate of V-1, return to ground or negative being through the filament of that tube, as before.

The 12-volt filament supply also enters Fig. 1 at the bottom of the drawing, and may be traced in a straight series line through the milliammeter, the filament rheostat R-6, the filaments of the two tubes, and the bias resistor R-3, from which it returns to ground.

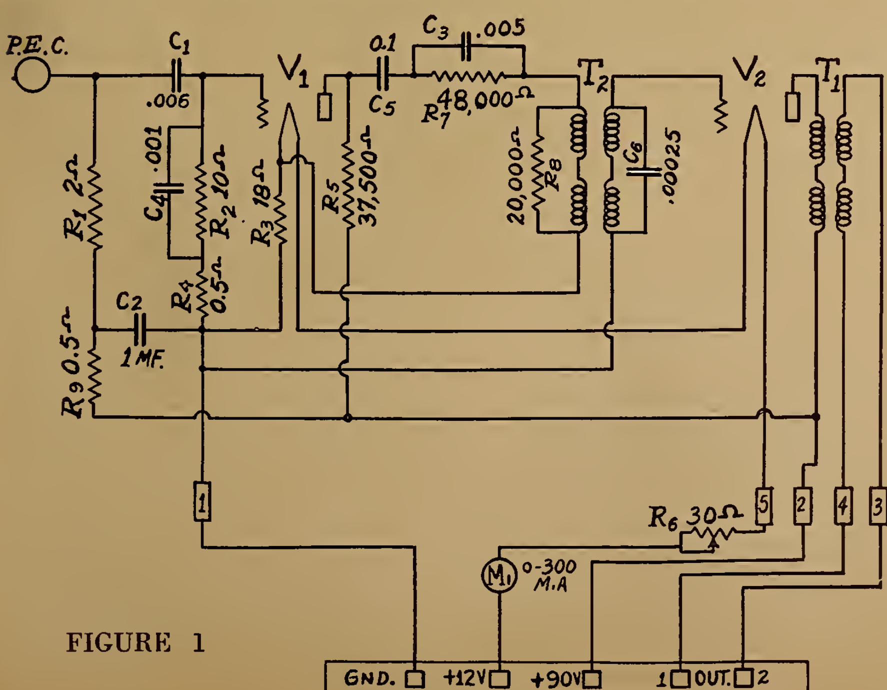


FIGURE 1

The major current in the bias resistor is the 300-mil filament supply, the plate current of the tubes being only a mil or so, and it is the filament current that furnishes grid bias. The grid of V-1 connects through R-2 and R-4—in which no d.c. flows—to the lower or negative end of R-3, and is therefore negative with respect to V-1 filament by the extent of R-3's voltage-drop: the grid of V-2 connects, through the secondary of T-2, to the same side of R-3, and the bias of that tube adds the voltage—drop through V-1 filament to the R-3 voltage-drop.

Speech a.c. developed in the photo-cell faces three parallel load circuits: one from the anode of the cell through R-1 and R-9 to ground; one from the anode of the cell through C-1, R-2 and R-4 to ground; and one from anode through C-1, through the grid and filament of V-1 (which constitute a condenser), and through R-3 to ground. The frequency response of these circuits is modified by the presence of C-4 and C-2. R-9 and R-4, C-4 and C-2, have been added to the original circuit as parts of the modification which adapted this amplifier to Wide Range sound.

Speech a.c. developed between plate and filament of V-1 faces two parallel load circuits: from plate through R-5, and thence through the power supply to ground and up through R-3 to filament; and right through C-5, R-7, and the primary of T-2 to filament. Wide Range modifications include change of C-5 from 1.0 mfd. to 0.1 mfd., and addition of C-3, R-7 and R-8.

Speech a.c. appearing by induction in the secondary of T-2 faces one load in the form of C-6, and another in the grid-filament capacitance of the tube, return from the filament being through R-3 to the lower end of T-2 secondary. C-6 is another addition. [The original circuit, of which Fig. 1 is a modified form, can be found on page 8 of I. P. for June, 1935.]

The primary of T-1 is, of course, the load upon the plate of V-2. The return from the lower end of that primary to filament is through the power supply to ground. The branch return through R-9 and C-2 is of no importance by reason of the comparatively enormous resistance (0.5 megohm) of R-9. The secondary of T-1 is wired, without further modification, to the output terminals on the bottom terminal strip. This is the circuit, as proved by interchange of these amplifiers between the two projectors, in which the origin of a rumbling, crackling noise had to be run down.

A strictly physical difficulty remains to be noted. These amplifiers, as many projectionists know, are shielded by

mounting inside substantial metal boxes. Originally the top and back of these boxes, as well as the face, could be opened for accessibility, but projector oil got in and rotted the insulation of the wiring, causing much trouble; thus, newer models were supplied in boxes entirely impervious to oil, and also to testing. Comparatively little of the amplifier is accessible through the front door. For most tests it was necessary to unsolder the five bottom wires and the photo-cell lead at the upper left, as well as a noise-reducing ground connection (not shown in the drawing) which soldered to spring suspension No. 5. Lastly, still another ground wire bolted to the amplifier frame, making eight connections in all to be removed each time the amplifier was taken from its housing, and replaced each time it was put back for test.

The first attack on the trouble consisted of removing the amplifier and inspecting all parts and connections. A few of the latter were touched up with a soldering iron, and the amplifier replaced in its housing. Noise continued unchanged. It was then necessary to isolate the trouble to some one portion of Fig. 1. Working through the open front door, the grid of V-2, which could be reached in that way, was opened and connected directly to ground. The noise disappeared, indicating that V-2 and its output circuits were guiltless.

The next logical step would have been to open the primary of T-2, but this was the least accessible part of the amplifier, and several illogical but practical chances were preferred. C-2 (also accessible from the front) was open-circuited, and the grid connection of V-2 was restored. The noise continued, indicating that leakage in C-2 was not the cause. R-1 and R-2, the only other parts easily accessible from in front, were changed without effect, and the amplifier was again removed from its housing.

The primary of T-2 cannot be reached, even with the amplifier outside the housing, unless its metal shell or frame is also disassembled. Therefore the next step elected was to open the plate of V-1; but in order to kill several birds with one stone R-5 was also replaced.

The wiring diagram agreed with Fig. 1 in showing two wires to the top of R-5—one from the plate of V-1 and one from the left-hand side of C-5. In the wiring diagram these wires did not join above the resistor, as in Fig. 1, but met at the top resistor terminal. The replacement resistor was so installed that its top terminal and the two wires in question could be reached from the front door of the housing. With both connected, noise continued, indicating that R-5 had not been faulty. With only one wire (seemingly the one to C-5) connected, noise stopped; when the other lead (apparently the plate of V-1) was also connected, noise resumed.

On the basis of these tests it was obvious that the noise had its origin in or ahead of V-1. But C-2, R-1 and R-2, the most likely causes, had previously been cleared. Merely as a check, before going through the work of again removing the amplifier from its housing, V-1 grid was opened and grounded. The noise continued! This final test apparently eliminated every possibility. The noise *couldn't be anywhere*—but it was as loud as ever!

Maker's Drawing Incorrect

The facts were reconsidered. Opening V-1 grid did not end the noise. Opening the plate of the same tube apparently did. But the tube itself had been changed two or three times, and the socket was a type that never gave trouble. All power and bias supplies were common to both tubes, and any irregularity there would be heard at lower volume even with V-1 plate open, by reason of its effect on V-2. Process of elimination had been carried to zero; the loud noise must be an illusion. Incontrovertible evidence proved that it *couldn't* exist!

A few hour's sleep preceded the conclusion that there must have been some flaw in a previous step. As a re-check, the plate of V-2 was opened again, but this time at the socket. The noise continued. For the purpose of investigating the wire between the socket and the top of R-5 the wiring drawing was again consulted and compared with the actual amplifier. Discovery! The drawing was wrong! The two wires shown in Fig. 1—and in the wiring diagram as well—as leading to the top of R-5 actually went to the bottom of that resistor, and *vice-versa.* The wire that was mistakenly believed to lead to the plate of V-1 actually went to spring suspension terminal No. 2. [It was opening this wire that had interrupted the noise.] Then where was the trouble? Not in or ahead of V-1, since opening the plate of that tube, it was now proved, did *not* interrupt it. Not in or behind V-2, since opening the B supply to the lower end of R-5 ended the noise completely. Therefore the difficulty was somewhere between V-1 and V-2, but not in R-5, which had already been replaced without effect. C-5 looked like a reasonable possibility. If that condenser were leaky, surges of

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933,

Of INTERNATIONAL PROJECTIONIST, published monthly at New York, N. Y., for October 1, 1937.

County of New York } ss.
State of New York

Before me, a Notary Public in and for the State and county aforesaid, personally appeared James J. Finn, who, having been duly sworn according to law, deposes and says that he is the Editor of INTERNATIONAL PROJECTIONIST and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, James J. Finn Publishing Corp., 580 Fifth Avenue, New York, N. Y.
Editor, James J. Finn, 580 Fifth Avenue, New York, N. Y.
Managing Editor, None.
Business Manager, Ruth Entracht, 580 Fifth Avenue, New York, N. Y.

2. That the owner is:

James J. Finn Publishing Corp., 580 Fifth Avenue, New York, N. Y.
James J. Finn, 580 Fifth Avenue, New York, N. Y.
Ruth Entracht, 580 Fifth Avenue, New York, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

JAMES J. FINN, Editor

Sworn to and subscribed before me this 27th day of September, 1937.
(Seal) Ottavio Grimaldi

Notary Public Queen's County No. 689; Certificate filed in New York County No. 179; New York County Register's No. 9-G—113. (My commission expires March 30, 1939.)

B current would circulate through it and R-7 to the primary of T-2, returning to ground via filament and R-3, and would set up induced disturbances in T-2 secondary. This proved to be the solution when C-5 was replaced and the amplifier restored for the last time to its housing.

Hasty Installation Jobs

An extra day of trouble, and extra night of work, had resulted from too trusting an assumption that wiring diagrams are accurate even in small details. In this case, however, such an assumption was to some degree justified by the great difficulty in getting at the amplifier itself.

One other case also refers to a trouble that could never have been found. Like a previous instance, also, it involves an ultra modern system, and a monitor speaker, one of the new kind that is provided with a separate monitor amplifier. The system had been installed under difficulties, inasmuch as the theatre did not close down for the change in sound, and some parts of the installation process had to be rushed to a certain extent in order to insure prompt opening every morning. In consequence, the job was not too well done, and a complete breakdown, with total outage of sound, had already occurred and been traced to poor workmanship in wiring up the amplifying panel. Reappearance of such difficulties in the future was none too improbable.

The case now to be reported made a dramatic entrance. An over-alert projectionist was watching the picture through newly-glassed ports, and listening intently to his new monitor, when the sound stopped abruptly. Remembering the previous difficulty, he moved smartly upon the system amplifier, cut off all power, and proceeded to check connections. When a phone call from below asked him why sound had stopped, he replied he was looking for the trouble. More competent and less excited investigation by the other member of the crew soon revealed that there was another loose connection, but at the monitor itself. Sound had never stopped in the theatre until the over-enthusiastic investigator cut the main power, and then it stopped with a bang. The total outage lasted about seven minutes, and the unfortunate cause of it is still being asked when he expects to find his trouble in the system amplifier.

Television, Projection Feature S.M.P.E. Meeting

By *JAMES J. FINN*

PROJECTION problems were accorded major attention by the S.M.P.E. Convention which met in New York City Oct. 11-14. Naturally, the discussion of the proposed new projector aperture highlighted the special projection session, the feature of an unusually well-rounded papers program. Several demonstrations, notably those of the RCA television system, a three-dimensional motion picture process, and W. E.'s "stereophonic" sound system, contributed materially to the success of the meeting.

Of particular interest was the imposing number of projectionists attending the sessions—so many, in fact, as to render impossible a complete listing herein. This is a happy augury for both the Society and the craft.

'Three-Dimensional' Pictures

The Wheelwright system of three-dimensional motion pictures featured the first day's session. This demonstration was awaited with keen interest by those who had seen the earlier showing before the Society; but it must be admitted that their hopes for a substantial improvement were not realized. This system (described in I. P. for July, 1936, p. 12) involves the taking of two simultaneous pictures, complimentary to each eye. Projection is accomplished by means of two reels of 16 mm. film run on two interlocked projectors, the two views being projected to the screen one over the other. Eye-compensating accessories (a long term for Polaroid glasses) are necessary for viewing the pictures. Mr. Wheelwright stated frankly that the system is purely experimental, and this answers all questions as to the status of the art.

W. E. showed its "stereophonic" or so-called three-dimensional sound in which the sound comes directly from the point of origin on the screen. Sound is picked up by two channels and the output of each is recorded on a separate sound track on the film. In other words, there are two separate tracks on the film each of which is a recording of just one channel. In the theatre, each track is fed to a separate set of speakers at the *sides* of the screen. W. E. asserts that this set-up gives "two-ear" hearing.

The writer, while greatly impressed by the quality of sound reproduction, is unable to appreciate the practical benefit of this system to theatres, particularly to the medium- and small-sized houses which comprise 80% of the exhibition field. "Two-ear" hearing means little with a 12-foot screen. I P. will publish details of this system shortly. Incidentally, W. E. announced that the system will not be marketed for quite some time, because of its great cost.

The projection session was presided over by Dr. A. N. Goldsmith, who himself read a short paper on "The Practice of Projection." Of particular interest was a paper, "Grading Projectionists," by G. P. Barber of the Alberta (Can.) Government. The paper revealed nothing new or startling, and on the whole was acceptable to practical projectionists. However, the writer dissents emphatically from the conclusion that the smaller theatres—say, of 600 seats or less—require either fewer or less experienced men on a shift than do those houses of over 600 seats. This proposition seems to be a fetish with Canadian officials. We'll have more to say about this matter when the paper is published herein.

Mr. T. P. Hover, of Lima, Ohio, who has contributed to I. P., presented the standout paper of the session in describing how cooperation between the Union members themselves, and between the Union and exhibitors, keeps the ball rolling on service in a small town that is unable to get prompt service on breakdowns. This paper is a "must" for publication herein subsequently, and its content should be studied by every Union in the country. Hover produced a series of howls with his anecdotes anent the exhibitor attitude toward projectionists, wage scales, and replacement parts. He mentioned one owner who, finally purchasing a badly needed tube or cell, locked it in the safe! Hover's appearance with such a fine paper was a great credit to the Union in particular and the craft in general.

A New Screen Idea

F. H. Richardson read two papers—one on perforated screens and another on screen image dimensions—which contained little factual data, but merely cited certain shortcomings and asked for suggestions tending toward their elimination. His shellacking of screen manufacturers on the score of ragged perforations seemed to the writer to be unwarranted.

Ben Schlanger, New York architect, took the wraps off a brand new idea in

his paper, "New Approaches to the Presentation of the Motion Picture Theatre." The plan includes a maskless screen backed up by a sort of inverted bowl having coves or louvers which slant away on all sides from the edge of the picture proper. The screen having no masking, and thus no sharp light cutoff, the excess light hits these louvers and is splayed out all around the screen. Naturally, this light diminishes as it travels farther from the screen.

Schlanger's idea apparently is that this "halo" about the screen will accentuate the mood, whether light or dark or in color, of the particular sequence being shown. One can either take this or leave it, but the idea is so startingly original that it merits description by Schlanger himself in these columns at an early date.

All-metal reflectors were again shown, but not explained in any degree, by the Heyer-Schultz Co. of Montclair, N. J. The briefness of the presentation made it impossible to accurately evaluate the worth of these reflectors; but it was brought out that their cost would approximate two and one-half times that of glass and that they would have an unconditional guarantee of one year against pitting and breakage. Questioned as to uniformity of production, the sponsor said that this problem had been overcome; but he didn't say how.

Chauncey Greene, a standout projection craftsman from Minneapolis, laid the ghost of 16 mm. projection as an acceptable substitute for 35 mm. projection in a paper which detailed many present shortcomings of the sub-standard system. Greene's paper was a crushing blow to those exponents (we could have said "promoters") of 16 mm. systems which are ballyhooed as "just as good" as 35 mm. stuff. When these 16 mm. people take care of all the defects enumerated by Greene they might have something; but before then the gullible purchaser of a 16 mm. outfit for professional theatre work will be just another shorn sheep.

I. Gordon opened a bagful of errors charged up to the West Coast production people, to the laboratories and to the distributors in such fulsome measure as to occasion surprise that the groups have sufficient time to think up new apertures and other "improvements" of the projection process. What Gordon proved against these people on the basis of samples of their own work is enough to send them into hiding, away from projection apertures, for the next year.

R. V. Fisher, of the Rochester, N. Y., Local Union, showed a device for cleaning the sound track during projection and a new fire valve—both of which items will be described in detail in these columns soon. Victor Welman, of the Cleveland Local Union, described a new recorder in a paper which narrowly missed being dropped from the program because J. J. Finn and Harry Rubin, two Goliaths of projection (well, at least one) took so long to make a few slides.

All in all, the boys made a fine showing for themselves and for their organization and did the outfit through the country a world of good in terms of added prestige and goodwill.

The Projection Practice Committee, headed by Harry Rubin, rendered a report that tore the Academy aperture proposal to shreds; but this is covered elsewhere herein.

RCA Television System

The big noise of the closing day's session was the demonstration of the RCA television system. Utilizing the 441-line system, this demonstration was impressive in the extreme and showed that the RCA men not only know what they are about but are coming along fast. Sixteen receivers each viewed by sixteen persons sitting in 4 rows (not raised), were mounted in a line. The show consisted of both film and live entertainment—two dramatic sketches, a comedy skit, harp solos and a newsreel. The show was picked up by the Iconoscope cameras in the NBC studios in Radio City, then relayed by coaxial cable to the transmitter atop the Empire State Building some 16 blocks away, and from this point broadcast to the receivers on the 62nd floor of the RCA building.

The battery of receivers showed images 7½ by 10 inches; while in an adjoining room the newly developed Kinescope, electron-gun set on a plane horizontal with the floor, projected the same image on a 3 x 4 foot screen. RCA announced that this was the first showing in history of black-and-white television images. Some images were just this, with the closeups sharply defined and well illuminated, the medium shots of fair quality, and the long shots being definitely poor. Changes of scene, while not instantaneous or flicker-free, were on the whole good. Obviously, RCA is adapting film technique to television production, and very well indeed.

The 7½ x 10 inch receiver images were not all of the same color: some were a pasty gray, poorly illuminated; others were a greenish-blue, and still others were a rather chalky white. Only about 4 of the 16 receivers appeared to this writer to be showing images that approximated black-and-white images of sharp definition. But these 4 images were exceptionally good.

The large 3 x 4 foot picture was the clincher for the writer. While failing by a wide margin to approximate the quality of the smaller ones, this large image conveyed to the writer better than any number of words could the thought that with a bit more polishing—more light of higher intensity and better definition—television would arrive. Many defects are apparent in this RCA system, but one has only to view this large image and be convinced that their elimination is but a matter of a comparatively short time—possibly within two or three years. After that—? It's anybody's guess.

Abstracts of a majority of the papers presented at the Convention are appended hereto:

NOMENCLATURE AND SPECIFICATIONS, INCLUDING DESCRIPTION OF THE VARIOUS TYPES OF MOVIETONE RELEASE

John K. Hilliard
Metro-Golden-Mayer Studios

This paper includes a general description of the following types of movietone sound track which are currently being released or will be released in the immediate future, according to plans:

1. Standard movietone; 2. Standard movietone with squeeze- or matted-track; 3. Standard movietone with double-squeeze- or matted-track; 4. Movietone push-pull; 5. Movietone push-pull squeeze- or matted-track.

6. Variable-area bilateral with bias; 7. Variable-area bilateral with shutter; 8. Variable-area unilateral bias track; 9. Variable-area push-pull.

During the past year all of the aforementioned tracks have been used to some extent in released movietone pictures. This paper shows samples of these various types of tracks and give a general description of their characteristics. A description is also included of the general technique involved in the recording and reproducing of the so-called "hot and cold" or "A and B" prints. During the past two years this particular type of print has been used very successfully in extending the volume range of the variable-density release to approximately 50 db. This release is intended to be shown only in theatres which have equipment adequate to reproduce music which is 6 to 10 db higher than average dialog.

A description of the mechanics and technique for re-recording using the squeeze-track is outlined. This procedure increases the noise reduction from 3 to 6 db, depending upon the amount of squeeze applied.

VACUUM-TUBE ENGINEERING FOR MOTION PICTURES

L. C. Hollands and A. M. Glover
Radiotron Division, RCA Mfg. Co.

This paper describes manufacturing and developmental technique of vacuum tubes, with particular reference to their use in motion picture equipment. A brief discussion of how application requirements affect the choice of materials, structural design, and electrical characteristics of phototubes and amplifiers of both power and voltage types is included. How tubes are designed to meet specific needs will be illustrated by actual examples taken from recent tube developments. Work on producing tubes having low-hum, low-micro-

phonic and low-noise characteristics is given as of special interest to the engineer.

STANDARDS COMMITTEE REPORT

There have been but two meetings of the Standards Committee since the last report. During the Summer, fourteen new drawings have been completed covering 8 mm. film standards, revision of the drawings for sprockets, and reels for 35 mm., 16 mm., and 8 mm. film, but only preliminary discussion of them has occurred.

The Standards Committee has given initial approval to the adoption of the spacing of 0.15 mm. separating the two halves of the push-pull sound track, but the balloting is not yet complete.

THREE-DIMENSIONAL PICTURES

George W. Wheelwright, 3rd

I. Historical background. II. Requirements of true stereoscopy—discussion of factors involved: a. Overlap, b. Detail, c. Diminution in size of known objects, d. Haze, e. Lighting effects, f. Two-eye pictures taken eye-distance apart.

III. Series three-dimensional work falls into two classes: a. Critical angle stereoscopy, and b. Anaglyph stereoscopy.

1. Use of colors to obtain stereoscopic pictures, Lumiere's work, and Audioscopics which have three disadvantages are examples;

2. Polarizing anaglyphs first operated by Anderton in 1893, and most recently through the use of Polaroid.

IV. Explanation of the advantages to be gained from three-dimensional pictures in color as opposed to single pictures using

the same color system. Discussion of experimental evidence that the two-eye picture has real advantages.

V. Problems to be discussed: a. Photographers need to learn: 1. Limitations, and 2. Technique of using this new tool for three dimensions.

b. Theatre production problems: 1. Changes in method of projection, 2. Area of best viewing, and 3. Distribution of glasses and their possible reuse.

VI. Thirty-five millimeter movies, full size, the "living movies of the future." Screen disappears; the actors, particularly in close-ups, appear to be present in person. The movies shown, when considered in connection with present technical excellence, will create final illusion of living movies.

VII. Use of a large area of Polaroid to explain the three fundamental principles of polarized light. Some of the new uses to which this will be put, and in particular, how the three-dimensional pictures are observed by the audience with the use of Polaroid.

DIE CASTINGS AND THEIR APPLICATION TO PHOTOGRAPHIC APPLIANCES

Charles Pack

Doehler Die Casting Co.

Die castings are defined as castings made by forcing molten metal into a metallic mold or die. The alloy most generally used is of the zinc-base type, having a tensile strength of approximately 40,000 lbs. per sq. inch. For photographic appliances, the alloys of lower specific gravity are more desirable. Aluminum base alloys are used more extensively in photographic appliances for that reason. Physical properties of various aluminum die casting alloys are given.

Since low specific gravity is of prime importance in castings used for photographic appliances, the development of the process of die casting the lightest of all commercial metals, magnesiums, is of particular interest to motion picture engineers. Magnesium is one third lighter than aluminum, and magnesium die castings are now being used wherever light weight is important. Physical properties of magnesium die castings are given.

Reference is also made to the die casting of brass and German silver, recently developed. Examples of die castings used in the construction of photographic appliances were used to illustrate the subject matter of the paper.

COOPERATION AS THE KEYNOTE OF PROJECTION SERVICE

Theodore P. Hover

Warner's Ohio Theatre, Lima, Ohio

At a recent meeting of the S.M.P.E. the chairman pointed out that engineers as a group are backward in dealing with problems involving the human element. They would rather deal with things than with persons. They cannot be blamed for this attitude, however, because most engineering problems can be solved by definite formulae and procedure; while problems dealing with the human element seldom follow the expected path.

This human element is a vital consideration in the successful operation of a theatre which requires that sound and projection equipment be maintained in first-class condition at all times.

It is the purpose of this paper to present plans and ideas which have aided us in

maintaining a high standard of projection in our city. Since this city is over 150 miles from the nearest parts supply company, a well-planned system of mutual cooperation is of the greatest importance in order to prevent shutdowns with attendant loss of money and good will. The success of these plans over a period of ten years recommends it to the consideration of other projectionists' organizations which are isolated from repair and emergency engineering facilities.

REDUCTION OF LOOP LENGTH VARIATIONS IN NON-SLIP PRINTERS

E. W. Kellogg

RCA Manufacturing Co., Inc.

Compensation for varying degrees of film shrinkage is accomplished in the Bedford Non-Slip Printer by changes in the length of a loop of film between a sprocket and the printing point. This involves an uncertainty of synchronism by the amount which the loop, as first threaded, differs in length from the final running loop. For most purposes, the present designs do not cause more change in loop length than may be readily tolerated.

For certain purposes, especially if this type of printer is to be employed for 16 mm. films, there may be too much departure for synchronism. A guide roller arrangement is described by which the necessary change in angle of approach of the raw stock to the printing point is attained with a comparatively small change in loop length.

Several possible arrangements are considered and some other features of the non-slip printer are discussed.

SAFEGUARDING AND DEVELOPING OUR FILM MARKETS ABROAD

N. D. Golden

U. S. Department of Commerce

American motion pictures are maintaining their immense popularity throughout the world, yet the barriers and obstructions which tend to limit their sale continue to be imposed abroad. Safeguarding and developing our Film Markets Abroad, "contingents" taxes and complex restrictions which continue to be slapped on, in all too many instances in foreign markets is one of the greatest problems American producers must face abroad. Some of these are legitimate enough, from the standpoint of local interests, but others appear to be inherently unreasonable. In certain cases our motion-picture industry may be justified in taking a strong and positive stand with the object of bringing about the rectification of unfair measures. We need not be unduly hesitant. Our producers and distributors can afford to make effective their opposition to merely narrow-minded or punitive practices, while at the same time conforming readily to rational and moderate foreign requirements. In any such stand they will have the backing of one momentous factor—namely, the avidity of foreign audiences to see and hear our magnificently entertaining films.

Foreign markets play a highly significant role in the success of our motion picture industry. They must be constantly cherished and cultivated and energetically safeguarded. It is noted that any strong wave of nationalistic sentiment in Central Europe, finding expression in restrictive laws affecting motion pictures,—or a movement toward control or rigid censorship somewhere in Asia, or some inimical reaction in a Latin American country—may contribute to an ultimate effect whereby a motion-picture engineer would find loss in his pay-envelope or might even be confronted by more severe emergencies.

The steady efforts of the Bureau of Foreign and Domestic Commerce to safeguard and augment American motion-picture markets by supplying a wealth of factual data and utilizing a variety of trade-promotive methods is covered in the paper presented.

FILM PERFORATION AND 96-CYCLE FREQUENCY MODULATION IN SOUND FILM RECORDS

J. Crabtree and W. Herriott

Bell Telephone Laboratories, Inc.

When motion picture film is flexed around a cylinder the film in the region of the sprocket holes does not follow a smooth curve. In a sound record this leads to frequency distortion of perforation frequency.

NEW APPROACHES TO THE PRESENTATION OF THE MOTION PICTURE

Ben Schlanger

Consulting Architect, New York, N. Y.

Recent trends toward the smaller-sized motion picture audience indicate that new considerations can be given to the possibility of a larger and differently shaped screen, retaining the 35 mm. film. The screen is pictured as completely occupying the entire forefront of the motion picture auditorium, assuming a space stage instead of an artifically framed picture.

RECENT DEVELOPMENTS IN HILL AND DALE RECORDERS

L. Veith and C. F. Wiebusch

Bell Telephone Laboratories, Inc.

A new sound-on-disc recorder has been developed in which is used the principle of feeding part of the output of the system back to the input of the associated driving amplifier in properly controlled relationship. The use of this principle which is widely used in feedback amplifiers replaces the usual practice of providing dissipative elements for the control of an electrically driven vibrating system. Heretofore no practical application of feedback to electrochemical systems has been made, possibly because the requirements for stable operation of such systems are difficult of achievement.

Through recent developments these requirements have been satisfactorily met. The new recorder is capable of recording on

wax or direct recording material without any effect on its characteristics which include a uniform response from 30 to 12,000 cycles and exceptional freedom from distortion products. The recorder is extremely simple and affords easy means for field calibration from the feedback element whose output is in direct proportion to the stylus velocity. These means also make available a monitoring voltage which, properly amplified, gives a precise aural picture of the stylus behavior during recording.

FURTHER PROGRESS IN FILM STORAGE

Capt. J. G. Bradley
The National Archives, Washington, D. C.

Research has been continued along the lines indicated by previous tests and reported at the Hollywood Convention. It has been determined that the cascade type of storage cabinet has certain advantages and may be relied upon to satisfactorily control film fires in a cabinet having a capacity of ten reels. A new method combining the advantages of insulation and cooling agent, while retaining the unit isolation features, is in the process of development, and a preliminary report will be presented.

Stainless steel insulated cabinets are now installed at The National Archives, and slides showing the completed installation were presented.

GRADING PROJECTIONISTS

G. P. Barber
Government of Province of Alberta, Canada

This paper describes the methods of licensing projectionists in the Province of Alberta, with some comments on the apparent benefits derived from the process. The process of becoming a first-class projectionist required a licensed apprenticeship of at least twelve months, followed by one year as third class, and, later, one year as second-class projectionist before taking final examination for a first-class license. Each period, except apprenticeship is preceded by a thorough examination.

COMMERCIAL 16 MM. PROJECTION FAULTS

Chauncey L. Greene
Projectionist, Minneapolis, Minn.

Because commercial motion pictures on 16 mm. film are an outgrowth of "home movies," the standards of projection are low. Less care is given to their proper presentation than is the case with theatrical showings of 35 mm. film, whereas, because of the greater overall magnification, more care should be given. Some of the more glaring faults are treated in some detail, a general treatment is set forth, and the importance of proper presentation is clarified by comparison of show-windows of the street and of the screen.

SPECTRAL DISTRIBUTION AND COLOR TEMPERATURES OF THE RADIANT ENERGY FROM CARBON ARCS

F. T. Bowditch and A. C. Downs
National Carbon Co., Inc.

Color temperatures of various carbon arcs have been calculated from spectral energy data. The dominant wave-length and per cent purity of each arc are given with reference to both "Average Daylight" and "Noon June Sunlight."

It is pointed out that the color temperatures of these carbon arc light sources are of value in comparing them on a visual basis only. The effects of the radiant energy from the arcs on any photosensitive medium other than the human eye—for example, photographic film—is very different from the visual impression.

Spectral energy distribution curves of several carbon arc sources are published for the first time.

RECENT DEVELOPMENTS IN GASEOUS DISCHARGE LAMPS

Saul Dushman
Research Laboratory, General Electric Co.

The paper describes the luminous and electrical characteristics of a number of vapor-discharge lamps which have attained practical importance in recent years. These include the sodium-vapor lamp, the high-intensity, mercury-vapor lamp, and the high-pressure quartz-capillary lamp. The fundamental physical phenomena are discussed briefly and also the manner in which these

effect the light output and efficiency. The effect of variations in gas pressure and current density on the distribution of intensity in the spectrum is dealt with and also the accompanying changes in intrinsic brilliancy and color of light emitted.

The latter part of the paper contains a discussion of recent developments in the utilization of fluorescent materials in gaseous discharge lamps. These lamps offer interesting possibilities from the point of view of general illumination and special color effects.

A RECORDER FOR MAKING BUZZ TRACK FILM

E. W. Kellogg
RCA Manufacturing Co.

The only requirement of a buzz track is that the track be of correct width and properly located with respect to the edge of the film nearest the track, and that the sound produced by a weave in one direction shall be readily distinguishable from that which results when the film is displaced in the other direction.

It is better that the buzz track film should be a direct recording rather than a print, since there is less chance of inaccurate location. A simple recorder has been constructed for the sole purpose of making buzz track film. It can readily be converted for 16 mm. All possible precautions are taken to insure correct track width and location.

In view of the small amount of buzz track required, it is contemplated that only one such machine will be needed.

ABSTRACT OF REPORT OF THE STUDIO LIGHTING COMMITTEE

R. E. Farnham, *Chairman*

The past year has witnessed unusual advances in both studio lighting equipment and technique of lighting, second only to the famous 1928 period when the studios partially adopted incandescent lighting. The cameramen are entering an era of "precision" lighting. Highlights and shadows are carefully balanced with dimmers as well as the placement of the units. This calls for equipment giving more accurate light control. The influence of lighting for color is creating a greater appreciation on the part of cameramen of the color quality of the light in black-and-white photography.

The report also tells of the development of a satisfactory filter of extreme accuracy, making possible the use of incandescent lamps of the "CP" type for Technicolor photography, either alone or when mixed with other suitable illuminants.

THE SOUND LEVEL MOTOR IN THE MOTION PICTURE INDUSTRY

H. H. Scott
General Radio Company

The modern sound level meter may be used as a convenient means for making a large number of measurements of value to the motion picture industry. Recent designs featuring light weight, small size, and convenience of control make modern sound level meters particularly well adapted for such purposes.

Among the many possible uses are: measuring noise levels in studios and theatres; measuring noise made by ventilating equipment, cameras, or projection equipment; measuring background noise level from reproducing system; checking overall frequency response of reproducing system; checking variation in frequency response throughout auditorium; checking level of re-

production in auditorium, etc. Typical data showing results obtained in a theatre were presented.

HIGH-SPEED PHOTOGRAPHY APPLIED TO DESIGN OF TELEPHONE APPARATUS

W. Herriott

Bell Telephone Laboratories, Inc.

High-speed motion pictures are employed at Bell Laboratories as a visual aid in the study of problems associated with the design, manufacture and testing of telephone apparatus. A new high-speed camera of the optical compensator type operating at 4,000 pictures per second is described, and its application to the study of problems associated with telephone apparatus is discussed.

DEVICE FOR CLEANING THE SOUND TRACK DURING PROJECTION

R. J. Fisher

Flower City Specialty Co.

A description is given of a device for cleaning the sound track or zone on which sound is recorded. It comprises a compact attachment applicable to all existing projectors without alteration of the projector mechanism, which is simple and sturdy in operation. Its object is to improve the reproduction of recorded sound by removing completely all dirt, dust and lint that lodges on the sound track during the process of projection, rewinding and shipping.

PRECISION ALL-METAL REFLECTOR POR PROJECTION ARCS

C. E. Shultz

Heyer-Schultz, Inc.

A paper dealing with the peculiar characteristics of an all-metal reflector regarding its resistance to tarnish, pitting, breakage and heat. A comparison is made between the present standard glass reflector and this new type as to reflectivity, dependability, accuracy, color response and longevity.

BACKGROUND PROJECTION PROCESS

G. G. Popovici

The complexity of the background projection process is generally known. It has been widely applied in cinematography with great success. A new field offers a tremendous opportunity, namely, still photography. Two types of such projectors are described, one to cover screens up to 10x12 ft., the other to cover screens up to 13x18 ft. During the research stage, some very interesting facts have been observed. The following elements of the problem are discussed:

(1) The spot condition, what causes it and how to reduce it successfully, even eliminating it entirely in specific cases.

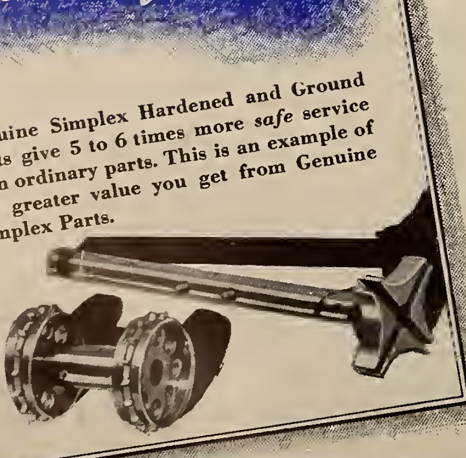
(2) Screen textures: Nitrate or acetate base sprayed with polarizing material for diffusion (Flatlight type). The new Trans-Lux screen of the high-transmission type.

(3) Theory of light refraction through screen. (4) Light brightness vs. diffusion of screen. (5) Optical conditions, condensers, objective lenses, etc.

(6) Light-source proper: Brightness vs. current, behavior of different types of carbons, spectral consideration in color projection. (7) Cooling the slides with air, a novel method incorporating refrigerated air for the super projector. (8) Projector electrical, optical, air-operating characteristics, including remote control of arc, douser, air-cooling system.

5 TO 6 TIMES MORE *Safe* SERVICE

Genuine Simplex Hardened and Ground Parts give 5 to 6 times more *safe* service than ordinary parts. This is an example of the greater value you get from Genuine Simplex Parts.



PLEASED PATRONS keep the coinometers clicking. And in these days of increasingly high standards and keen competition *only* the finest projection will KEEP them pleased.

You can't afford to impair the original fine projection qualities of your Simplex Projectors by using imitation parts—for, IMITATION PARTS GIVE IMITATION RESULTS.

Insist on Genuine Simplex Parts when you have your projectors repaired. Then—and *only* then—will you get parts which possess the extreme accuracy and wear resistance which are absolutely essential for perfect projection.

Genuine Simplex Parts are now sold at 36% off list. Their cost is so small that you can't afford to take a chance with imitations.

INTERNATIONAL PROJECTOR CORP., 88-96 Gold St., New York, N.Y.

DISTRIBUTED BY NATIONAL THEATRE SUPPLY COMPANY

Ip

International PROJECTIONIST

NOVEMBER 1937 Vol. 12, No. 11

25c Copy

$2 a year


LIGHT
UP—
..and live!
HIGH INTENSITY PROJECTION IS
NOW INDISPENSABLE TO HOLD AND INCREASE PATRONAGE

International

PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

***Edited by* James J. Finn**

Volume 12 NOVEMBER 1937 *Number 11*

Published Monthly by

JAMES J. FINN PUBLISHING CORPORATION

580 FIFTH AVENUE, NEW YORK, N. Y.

Circulation Manager, Ruth Entracht

Subscription Representatives

Australia: McGills, 183 Elizabeth St., Melbourne
New Zealand: Te Aro Book Depot, Ltd., 64 Courtenay Place Wellington
England and Dominions: Wm. Dawson & Sons, Ltd., Pilgrim St., London, E. C. 4.

Yearly Subscription: United States and possessions, $2 (two years, $3); Canada and foreign countries, $2.50. Single copies, 25 cents. Changes of address should be submitted two weeks in advance of publication date to insure receipt of current issue. Entered as second-class matter February 8, 1932, at the Post Office at New York, N. Y. under the act of March 3, 1879.

MONTHLY CHAT

REVISION of the present standard aperture apparently is a dead issue, both the Academy and SMPE camps having maintained a discreet silence following the rather tart exchange of opinions on this topic six weeks ago. The Academy, notwithstanding the SMPE blast directed against the proposed change, announced that it would go ahead with the project—but no report of any progress has been forthcoming.

As for the SMPE, it still would like some provision made for confining photographed action within safe limits, in line with its recommendation of last Spring. As to this Hollywood says nothing. All of which contributes something less than zero to the solution of a pressing reproduction problem. Ah, these prima donna technicians.

CURRENT happenings in the theatre supply and the sound equipment servicing branches of the industry are of more than passing interest to projectionists. Why we think so is spread upon the record elsewhere herein.

WE AGAIN solicit your interest in and patronage for the sale of Xmas Seals, that tiny bit of paper that has done a mighty job in helping to banish tuberculosis from this earth. Many of our own were and are included in the ranks of those helped by this sale. Pay off—buy Xmas Seals.

THE answer to our own question in this corner in September: A single film frame is stationery in front of the aperture 1/32 second. The picture is exposed to the screen in two periods each of 1/96 second, making a total screen exposure of 1/48 second. Do you know how these figures are obtained?

SAYS a West Coast publication: "It is quite a fad by some writers . . . to refer sadly and patronizingly to Hollywood as being dependent upon sources located elsewhere for the development and improvement of its technical phases. There was a time when this was true but it has long since passed."

Nobody disputes Hollywood's superiority in production matters; but its record to date on visual and sound reproduction problems leaves much to be desired. It's the old story: for horses a horse doctor; for shoes a shoemaker, and for projection problems those men who through long experience know projection. Let Hollywood make the pictures. We'll project them.

METAL mirrors, now in development for many years, still haven't shown enough merit to warrant any large-scale displacement of the conventional glass types. This is our answer to numerous inquiries received on this topic. One can't foresee what the next six months or a year will bring in this direction, but the correct answer currently is "No."

POWERFUL WHITE LIGHT

BRENKERT ENARC
Gives It To You!

Only high intensity can give the power and depth and clearness of light that modern motion pictures need. Your theatre—regardless of its size—must have this light.

Simplified High Intensity is not costly, but highly profitable in increased admissions.

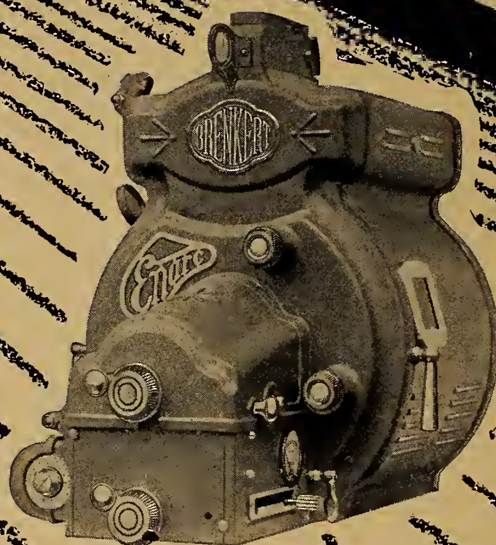
Simplified High Intensity at its most efficient development is BRENKERT ENARC, the projection lamp that gives you everything. Three times as much light as low intensity, yet with an increased cost so slight that one more ticket sale per show will pay for it.

BRENKERT ENARC Simplified High Intensity solves your sales problem! Ask the capable Brenkert Dealer near you for full particulars.

Brenkert Installations Increasing Faster Than Any Other Make Of Projection Lamp

---

Reliable Brenkert Dealers From Coast To Coast Are Ready to Give You Real Service



SIMPLIFIED
High Intensity
PROJECTION

INDISPENSABLE FOR YOUR THEATRE

BRENKERT LIGHT PROJECTION CO.

ENGINEERS AND MANUFACTURERS

DETROIT, MICHIGAN, U. S. A.

INTERNATIONAL PROJECTIONIST

VOLUME XII NUMBER 11

NOVEMBER 1937

AN ANALYSIS OF IMPERFECTIONS APPARENT ON THE SCREEN

By *A. C. SCHROEDER*
MEMBER, PROJECTIONIST UNION 150, LOS ANGELES, CALIFORNIA

Here is a pertinent reminder of everyday screen defects of such common occurrence as to be almost taken for granted by projectionists, together with a summary of the more unusual troubles, past and present, which escape casual notice.

II.

MOST projectionists cut the aperture so that the sides or margins are parallel, thus obtaining the proper shape, but this serves only to accentuate the slant of any vertical lines near the sides, the line starting in the upper portion of the picture and slanting toward the outer edge as it goes down, sometimes running out of the picture before terminating. Where the projection angle is steep (with the machine setting on the lens, so to speak) the screen is sometimes tilted back at the top. This artifice improves matters, squaring up the picture somewhat and aiding the focus. However, the screen image looks "funny," especially to those sitting down front.

Foreign objects and splotches on the screen have their counterpart in the image produced there by foreign matter in the aperture or in the space between the lens and the screen. Fuzz, dirt and hair often become lodged in the aperture. Dirty film aggravates this condition. Dirty film results from contact with the floor, especially one that is not kept clean. An oily film picks up more dirt than does a clean one. Assuming that the projectionist cleans the aperture, there should be no dirt present at the start of the reel. Despite every precaution, however, something or other will at times get into the aperture during the time between the threading and the projection of a reel.

Various methods are used to dislodge such objects. On the Simplex using the removable aperture mask I find that the foreign particle usually can be removed by a puff of air directed into the slit into which the mask fits, right at the edge of the front plate. A breadth of air will often suffice; but when this fails, we have a bellows handy that usually, but not always, does the trick. If the bellows fails, the glass is removed from the eyeshield and the bellow used there directing the blast against the front of the film. If the dirt is on the other side, the blast is directed there, first pushing back the lens tube. If all else fails, the mask may be pulled out very rapidly, cleaned, and snapped back into place. If the movement in and out is fast, it can hardly be noticed on the screen, and with black screen masking the sound track will be barely perceptible along the left edge of the picture.

Removing Foreign Objects

In the old days we used a wire with a slight bend in it, the end having been rounded and smoothed off to avoid scratching the film. This was placed into the hole in the cooling plate and run around the aperture hole, allowing it to touch lightly against the moving film. There may be danger of scratching, but we have never damaged film in this way. The idea is to barely touch the film and to keep the wire moving rapidly, so that it does not remain long

in one position. Only the very end of the wire can be seen on the screen, that part of wire only a small distance from the film being so far out of focus as to be unnoticeable.

Who has not been pestered with bugs, moths, *etc.*, flying against the porthole glass? The best one I heard was about a bat, which in its flight frequently cut through the light beam, not helping the picture any.

Travel-ghost is nearly a thing of the past, for two reasons: (1) improved mechanisms, and (2) the sound picture. Years ago much streaking on titles or white objects was due to the uneven cranking of worn mechanisms. Cranking a projector is unknown to the newer projectionists. It seemed simple, but it had to be learned. When the old machines were cranked unevenly the shutter and the flywheel would not slow down at the same rate, resulting in one getting ahead of the other and throwing the shutter out of time, until the driving power was again sufficient to drive them both, when the relation between shutter and flywheel was corrected automatically. After motor drives were introduced a bad belt hook or a "catch" in the mechanism occasioned this intermittent streaking.

Oldsters will remember also the frame line that moved up across the picture, continuing for quite some time. Framing was impossible until the critter finally came to rest, and when it did, it was impossible to tell where it would wind up: one might have to frame up or down, or it might even stop in frame. The only remedy for this, of course, was to cut out the entire section of film. The first time this happened to yours truly it drove him almost batty.

And now, just a few words on the delicate subject of scratches. It is inevitable that everyone has scratched, or will scratch, film. Of course, the exchanges and the studios *never* scratch film. Haven't they said so themselves? We use first-run film and when we get a bad print it is returned immediately.

Light coming through the doors ruins the picture, and while this condition is not very prevalent now, we still see it occasionally. Even in the better houses the doors are often opened at the end of the picture, flooding the screen with light. This is not confined to the daytime; quite often light from automobiles, etc., comes through the doors at night. At our theatre there are large floodlights across the street, illuminating the forecourt. These lights hit the screen when the doors are opened.

Extraneous Light on Screen

The straight picture theatre seldom has lights behind the screen, but houses having a large stage may have light shining through the perforations. This happened to us sometime ago. The manager called up about stray light "from the projection room" showing on the screen, and would we check up on it? We checked plenty—in fact we worked in practically a dark room for fifteen minutes, trying to locate it. Such light comes from the machine around the lens when the escutcheon is missing, or from either a cracked condenser or a crack in the glass in the ports. We found nothing wrong in the projection room. This continued for several reels, until we woke up and asked the stagehands if their lights were hitting the screen. Sure enough, there was the trouble.

Sometimes the projectors are so low that the people in the balcony get their head in the light as they go by. Then there is the young generation who throw their caps into the light. I worked in one theatre having a walk in front of the projection room going to the manager's office. This necessitated crouching to avoid the light as one went past the ports. Many times the head or back was not quite low enough and so partially obstructed the light. In another room it was necessary to pass *in front* of the right machine to get to the machine at the left. The projectors were set low, as there was a beam in front of the room underneath which the picture was projected. This made it all the more difficult to crouch low enough when passing in front of the machine, and many times the projectionist got into the light, throwing a shadow on the screen. This theatre still is operating but the projection room has been moved half way down toward the screen and placed over against the side wall! Can you imagine the side angle they have and the shape of the picture?

Correct Framing Problem

One of the troubles we have now that was not often seen during the silent days is characters on the screen with the heads and feet partially cut off. The framing lever or knob is not often changed these days, and such things should not occur, but the studios do not always get everything in the right place, resulting in some parts being too near the margin. The projectionist may be looking at the screen, but may not see it immediately. This process of looking becomes mechanical at times, and the picture suffers as a result.

Starting out of frame seems inexcusable, and yet, it will happen occasionally. This sometimes occurs when the machine is threaded without setting the movement in the locked position. We have a white mark painted on the shutter hub for just this purpose.

Projectionists will go to any extreme to avoid a stop. The causes of this trouble are many and varied. Our own experience along this line is due almost entirely to failure of power supply. Much of the Los Angeles power is carried over the mountains by "high lines" which are subject to troubles during electrical storms, causing power failure, usually for only a few seconds, but it interrupts the performance. At times the current failure is so short that the fire shutter stays up, the arc does not go out, but the picture flickers something awful and I need not tell you what the sound is like. Of course, frequently show comes to a complete stop. When this happens we call the engineer and have him start the emergency set, a large Winton engine coupled to a 1200-ampere generator. The regular supply usually comes back on before the emergency set is going.

In connection with the emergency set, which is d.c., there is a small alternator, run by a d.c. motor, which is in turn run from the large generator. The alternator supplies whatever a.c. is required for amplifiers, miscellaneous transformers, machine motors, *etc.* Obviously, switching over onto the alternator and switching the arcs onto the emergency set all takes a little time, and the regular supply is usually back before we can get it all cut over.

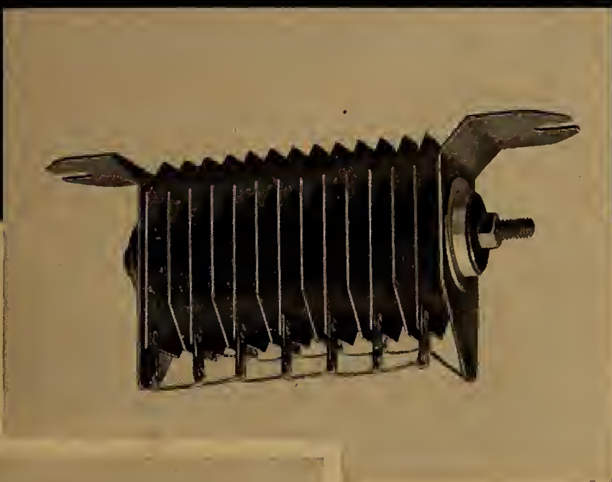
Our regular generator is about 200 feet from the projection room and is controlled by a remote automatic starter. One night we received a frantic call from the engineer telling us to switch over to the emergency set as the regular set was about to go out. This was at the time that Los Angeles was changing over from 50 to 60 cycles, and the emergency set was anything but reliable, due to the fact that the city engineers had been changing the characteristics of the big generator. It still was a botched up job and anything was liable to happen if we tried to use it.

One of us went down to see what was wrong. One of the contactors in the starter was at yellow heat, and the engineer was daubing water on it with a paint brush, (not the best sort of practice, but it was getting us by). We decided to cut the current down to the minimum and try to run the rest of the night, an hour and a half, on the regular set rather than try to use the emergency generator. Due to the decrease in arc curent and the practice of lighting the arc after the machine had already been started we got through the night. The light was not of the best, needless to say.

If you expect to install new projector heads, first make every effort to obtain the new heavy bases also. The new Super Simplex and Peerless lamps are too heavy for most old-type, non rigid bases, and vibration will almost certainly ensue.

G-E COPPER OXIDE RECTIFIERS-

BEST BECAUSE THEY ARE BUILT RIGHT



G-E COPPER OXIDE STACKS

These copper oxide stacks are the heart of G-E Copper Oxide Rectifiers for Projection Service. Extensive research in copper . . . exacting methods of oxidation and manufacture . . . test after test insure superior operating characteristics and long life. No other type of dry rectifier can perform as long and efficiently as a General Electric Copper Oxide.

G-E COPPER OXIDE UNIT ASSEMBLY

Notice the assembly of these copper oxide stacks in the case. It is compact and built to last. Heavy steel brackets support units at each end. They also serve as electrical connections. Heavy copper bus bars interconnect the stacks. This method of mounting copper oxide units eliminates the usual multiplicity of connecting wires and soldered joints.

THE COMPLETE UNIT

The G-E Copper Oxide Rectifiers for Projection Service can be installed wherever convenient. They are so cool and quiet in operation that many installations are made in the projection booth. The exterior is free from switches and controls. By connecting a pair of the G-E Copper Oxides in series, a spotlight may be operated.

TWO-PIECE CONSTRUCTION

To make handling and installation easier, the G-E Copper Oxide Rectifier is made in two sections. The bottom section contains the stacks, control relays and patented blower system. The top section contains the transformer section and control panel. Primary and secondary taps permit a wide range of adjustments. The output is exceptionally smooth.

BEFORE Installing G-E Copper Oxides		AFTER Installing G-E Copper Oxides	
Period Covered	Kilowatt Hours*	Period Covered	Kilowatt Hours*
Feb. 4 to Feb. 11	1094	Mar. 25 to Apr. 1	782
Feb. 11 to Feb. 18	1022	Apr. 1 to Apr. 8	786
Feb. 18 to Feb. 25	1090	Apr. 8 to Apr. 15	768
Feb. 25 to Mar. 4	1048	Apr. 15 to Apr. 22	712
Mar. 4 to Mar. 11	1038	Apr. 22 to Apr. 29	696
Mar. 11 to Mar. 18	1080	Apr. 29 to May 6	724

* Indicates total power used by theatre.

THESE FIGURES PROVE ECONOMY

The "Before" and "After" tabulation shows how economical the G-E Copper Oxide is. The power company serving the theatre made the power measurements. The average savings per week (total theatre load including projection booth) was 315 kilowatt hours.

SEND FOR FULL INFORMATION. ADDRESS SECTION A-511, APPLIANCE AND MERCHANDISE DEPT., GENERAL ELECTRIC CO., BRIDGEPORT, CONN.

GENERAL ELECTRIC

SPECIAL RECTIFIERS

APPLIANCE AND MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONN.

FUNDAMENTALS OF SOUND RECORDING AND THEATRE REPRODUCTION

By *FRANK T. JAMEY, JR.*

IV.

THE invention of the vacuum tube which made possible the amplification of minute electrical currents to a useful intensity, more than any other single event, made possible such modern conveniences as telephony, wireless and radio communication, and the mechanical recording and reproduction of sound. In the case of recording on, and reproducing sound from, film, it was, of course, necessary to convert the sound waves into light waves in order that they might be photographed on the film. However, it was at once evident that this was not a practical conversion without first transforming the sound waves into electrical waves, amplifying them to a useful intensity, and then converting the electrical waves into light waves for the photographing process. Just the reverse procedure is followed to reproduce the sound from the film.

It is interesting in a general way to investigate the basic principles of a vacuum tube amplifier without getting too involved with the highly technical details surrounding its design. We have already in a previous article discussed the characteristics of a three-electrode vacuum tube. To best present the problem let us consider a simple transformer repeating amplifier such as is shown in Fig. 1.

The input, consisting of an alternating current from either a microphone or a photo-electric cell, as the case may be, is connected at D and stepped up by means of the transformer T, after which it is applied between the grid and filament of tube No. 1. This produces a corresponding variation of the plate current of tube No. 1, which is, of course, of greater intensity than the input current. The varying current flowing through the primary P1 of the transformer T1 induces a voltage in the secondary S1. This voltage is applied to the grid and filament of the second tube, and thus the varying signal voltage is "repeated" from the first into the second tube and finally from the second into the third tube, increasing in intensity each time until it is large enough to properly actuate the recorder or the loudspeaker.

A great many factors govern the efficiency of such an amplifier, of course, such as the voltages of the various plate supplies, B1, B2 and B3, and the correct proportioning of the primary and secondary of the repeating transformers.

The types and design of the amplifiers used for sound motion picture equipment depend on the conditions imposed. Today tubes which can be operated from an a.c. power source, without the introduction of extraneous hum, make possible the elimination of cumbersome batteries. Constant improvement of vacuum tubes now makes it possible to achieve the required amplication with relatively few tubes. These tubes, likewise, operate with low plate voltages which permit the use of relatively small and inexpensive transformers.

On the other hand, present-day requirements for high quality make it necessary to use tubes that need not be overloaded, in which case distortion is introduced, and yet produce the desired amplification. For this reason many amplifiers employ what is known as push-pull power stages where the work is split up among two tubes to avoid the possibility of working the tube at a condition where distortion occurs. Furthermore, high quality filters are required.

The amplifier described is, of course, one of the simplest battery-operated circuits. In the early days of sound pictures it was necessary, due to the haste employed and the lack of experience in theatre operation, to make use of these simple circuits employing both dry- and wet-cell batteries for power sources. The amplifiers were bulky in design and not as practical as desired. Nevertheless, looking back on that period, it is really remarkable how well the industry got along with that type of product.

During the first years of that period, efforts were made to perfect a vacuum tube for both radio and theatre amplifiers that could be operated directly from the a.c. power lines and yet not have objectionable hum introduced into the audio-frequency circuits of the amplifier. This was soon accomplished, with the result that the cumbersome, bothersome batteries and motor-generator sets could be discarded. This, of course, made for simpler amplifiers of greater dependability. The battery-operated amplifiers had to include a number of meters and switches which could now be entirely abandoned. Projectionists were at first opposed to the elimination of some of these meters used for constant checks on the equipment; but they soon learned of the dependability of the new amplifiers and appreciated the simplicity of the unit.

During the same period, and even up to the present time, recording engineers were making improvements which, in almost every case, involved lower recording levels requiring greater amplification in the theatre. After a few years experience it was pretty well determined that theatres could be divided up into four groups, each group requir-

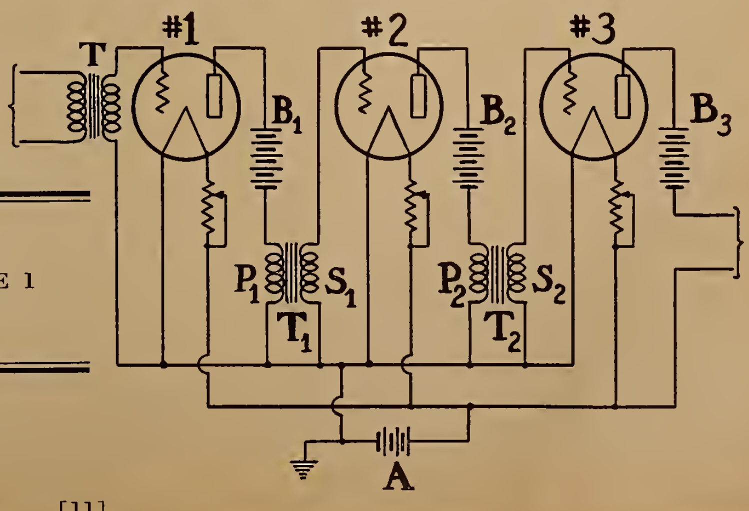


FIGURE 1

ing amplifiers of progressively greater power output and, at the same time, speakers of greater power-handling capacity and wider distribution.

By this time, it was also evident that amplifiers had to be designed for simple and quick installation, easy servicing, and, for certain special purposes, light in weight and small in size. Characteristics such as freedom from microphonics, filament power consumption, and ability to produce the required gain or power output with minimum harmonic distortion were also important.

Fortunately, tube engineers have been able in the past few years to very much improve vacuum tubes so they can now perform the functions that previously had to be taken care of by several tubes, and can now develop power outputs of equal intensity with smaller plate currents. This latter characteristic materially reduces the size and cost of the power transformers and protective measures previously required.

From both the installation and service points of view, the amplifiers had to occupy a minimum of floor space in the projection room, had to provide easy accommodations for conduit connections, and had to be designed so that those parts which might during ordinary operating conditions give trouble could be easily replaced. In the design of such amplifiers, great consideration had to be given to each part to insure dependable operation. At the same time the matter of elimination of extraneous noises required careful shielding of transformers. Parts had to be designed to withstand a wide variation in operating temperatures and humidities.

The projectionist, of course, required certain aids to permit simple and accurate control during operation. A volume control which could be easily read from a reasonable distance had to be provided, so designed that it would give adequate and yet uniform variation over the entire output. In most cases it was found desirable to provide auxilliary volume controls in some form at each projector station so that levels could be uniformly maintained for different pictures by cueing and pre-setting. This was particularly necessary when going into the newsreel and then following with the feature. Some means had to be provided to indicate if the power supply to the amplifier was on. It was desirable to provide a means of quickly determining if the plate current to the power tubes was on at all times. It was desirable, if possible, to place the tubes so that the projectionist could quickly determine if the filaments were burning. And, of course, some positive, simple means of sound change-over had to be made available.

In some cases, it has been necessary to provide pre-amplifiers, because it was impossible to transmit the minute signals created by the photo-electric cell to the main amplifier, which may have been placed anywhere from 10 to 50 feet away from the projector, without too great a loss. These pre-amplifiers then had to be located at the projector where they were subjected to vibration and to oil leaks. These conditions were by no means ideal. The circuit whereby the minute signals were converted by a transformer, so that they could be easily transmitted distances up to 100 feet to the main amplifier without the necessity of such a pre-amplifier, proved to be superior.

It is interesting to note that in many cases today separate amplifiers are used for the monitor speakers. This is provided so that any desired level of sound can be easily obtained from the monitor loudspeaker without in any way effecting either the volume or the quality of the sound from the stage speakers.

Furthermore, as mentioned in previous articles, the acoustic conditions of each theatre auditorium make it necessary to provide in the amplifier some means for controlling the frequency characteristic. This is sometimes provided inside the chassis in a manner that may only be adjusted by the service engineer or by controls on the panel which the projectionist can set. Another control, usually located inside the chassis, makes it possible to safeguard the amplifiers if the line voltage is found to be constantly higher than the average.

Light Wave Transformation

All of these factors and requirements make it quite evident that to design and manufacture an amplifier which will increase the intensity of the minute signals created by the photo-electric cell to a point where it operates the loudspeakers; to care for the wide range of frequencies (40 to 10,000 cycles per second); and to meet all of the mechanical requirements outlined, is no easy task. Yet it has been done.

The transformation of the light waves into electrical waves is a very interesting one. The photo-electric cell, the device that accomplishes this, is one of the most important factors in the development of sound motion picture equipment. It has been found that there are certain metals which will emit electrons when light is directed at them. One of the most efficient of these metals is caesium. By coating the inside surface of a half-cylindrical piece of metal with caesium about one molecule thick, and by placing it in a gas-filled bulb in such a way that the light beam which passes through the sound track on the film may be easily directed at it, and by connecting this cathode to a prong in the base of the bulb, such a device can be made effective. A plate is also placed in the bulb, and a small d.c. direct current is imposed between the plate and the cathode. Thus, when the varying light waves reach the cathode, electrons in direct proportion to the intensity of the light waves are emitted by the cathode, and are at the same time directed by the exciting current to the plate. The result is a minute electrical current which can be connected to an amplifier which varies in direct proportion to the light waves on the sound track.

Amplifier Classification on Basis of Operation

Amplifiers may be divided into two main classifications, namely, voltage amplifiers and power amplifiers. A voltage amplifier is one intended to deliver a large alternating voltage into a high-resistance load. A power amplifier, on the other hand, is designed to deliver appreciable power and may or may not require power to drive its grid circuit.

Amplifiers are also divided according to their method of operation into Class A, Class AB, Class B and Class C amplifiers. In a Class A amplifier the plate current is a faithful reproduction of the wave form of the applied grid voltage over a complete cycle. In Class AB, this is the case for more than 180 degrees but less than 360 degrees; in Class B for only 180 degrees; in Class C for less than 180 degrees.

Multi-stage amplifiers generally consist of several stages of voltage amplification followed by one or more stages of power amplification. The total amplification in amplifiers is limited by miscellaneous noises such as thermal agitation and "shot effect" which occur in the first stage and are amplified along with the desired signal. When the amplification reaches the magnitude that these noises become a large part of the output, the amplifier becomes useless. Therefore, it is necessary to keep noises down, especially in the first stage. Operating them at lower voltages and using special tubes are some of the remedies employed.

The immediate acceptance of this Simplified High Intensity Projection can be attributed to the tremendously increased volume of light made available at a cost that even the smaller theatres can afford.

. . . . . . embody the correct design, engineering skill and careful manufacture only experienced specialists can offer.

An Invitation!

Write for interesting catalog and name of your nearest Independent Theatre Equipment Dealer. He will, without obligation, arrange to demonstrate the Strong High Intensity Lamp in your theatre.

The STRONG ELECTRIC *Corp.*

2501 LAGRANGE ST. TOLEDO, OHIO, U. S. A.

EXPORT OFFICES:

ROOM 2002, 220 W. 42nd ST., NEW YORK, N. Y.

STEREOSCOPIC MOTION PICTURES: PAST, PRESENT AND FUTURE

By *G. W. WHEELWRIGHT*

LAND-WHEELWRIGHT LABORATORIES, BOSTON, MASS.

The historical background of three-dimensional motion pictures is first discussed, leading up to the requirements of true stereoscopy and a discussion of some of the factors involved, such as overlap, detail, apparent sizes of objects, haze, lighting effects, and two-eye pictures taken eye-distance apart. Serious three-dimensional work falls into two classes: (a) critical-angle stereoscopy, and (b) anaglyph stereoscopy. Under the latter heading falls the use of colors to achieve stereoscopic effects, as in Lumiere's work, and Audioscopics, which have several disadvantages; also polarizing anaglyphs, first operated by Anderton in 1893, and most recently through the use of Polaroid.

Advantages of three-dimensional pictures in color as opposed to single pictures using the same color system are explained. Some of the problems of photographers and theatres in using the Polaroid system are discussed. This paper was first presented before the Fall, 1937, meeting of the S.M.P.E.

THE subject of stereoscopy is age-old, as we all know. Leonardo da Vinci in some of his writings indicated that he understood the principle of two-eye pictures and the geometrical differences between what one eye saw and what the other eye saw. The original work of making mechanical devices that would reproduce for us the stereoscopic effect we should have seen if we had been present was started between 1832 and 1837. There is some discussion whether Mr. Eliot or Professor Wheatstone did the first work. Certainly, Eliot's suggestions were that one should hold the pictures in such a manner that one's eyes were crossed when viewing a pair of pictures, and he showed a mechanical means for preventing each eye from seeing the picture not intended for that eye. It was Wheatstone, however, who did the excellent thorough-going analysis of stereoscopy.

Another famous man of that period, Sir David Brewster, also gave considerable time and attention to the subject. Whereas Wheatstone had held two pictures and viewed them through mirrors so adjusted that each eye saw only its own picture, Brewster conceived the idea of using first two lenses and, later, parts of two lenses to make up the familiar device known to us all as the stereoscope. This device employed two pictures taken eye-distance apart and shown to our eyes through a box-like device, each eye having its own lens focused upon its own picture. It was far simpler to use and more practicable for general use than the Wheatstone viewer. It suffered from the serious disadvantage in close analytical work that pictures could not be substantially greater than 2½ inches in breadth, which is, roughly, the normal eye separation of the human being . . .

Soon after this, stereoscopes enjoyed an enormous popularity, and every amateur, as well as a host of professional photographers, was taking stereoscopic pictures. Among the many possible reasons for the subsequent loss of interest in stereoscopy, two stand out: many persons, due to ignorance of the subject or the desire to fool the gullible public, took only one picture of the scene they were making, duplicated it, and showed it separately to each eye. Although this duplication creates in the mind of the observer something different from the ordinary viewing of a single picture, it of course does not give true stereoscopy.

The second, and perhaps more important, reason for the brevity of the stereoscope's popularity, is the fact that during the observation of the picture the observer completely cuts himself off from the rest of the world. This is essentially an unsocial act. When viewing pictures with a party of friends, it is difficult, if not impossible, for all members of the group to enjoy simultaneously the reactions that the observer personally is enjoying.

In the case of serious study or consultation by a group of men, such as doctors viewing *x*-ray stereograms, these stereoscopes greatly lengthen the period of examination and consultation; and often such observers subsequently do not agree to what they saw individually. If they had all been able to look simultaneously, they could have reached a conclusion more rapidly and with less uncertainty.

It is worth while to consider the requirements of true stereoscopy. The various factors that contribute to the perception of depth are:

(*a*) Overlap. In a single picture the branch of a tree, for instance, cuts across a person's body, thereby showing that the branch must be in front of the person, while not telling exactly how far in front.

(*b*) In a single picture, a noticeable concentration of detail in the foreground and lack of such detail in the background.

(*c*) In a single picture, the diminution in size of known objects such as telegraph poles along a roadside running off into the distance.

(*d*) In a single picture, haze and general blue tone of distant scenes.

(*e*) In a single picture, lighting effects. It is well known in the art that depth effects can be greatly enhanced by clever lighting. A common trick of the expert photographer is to place long shadows in his picture. Other such devices produce stronger suggestions of depth than does the amateur's usual flat lighting.

(*f*) Two pictures taken eye-distance apart and observed in some manner such that each eye sees its own, and *only its own*, picture. It is probably safe to say that no serious attempt at stereoscopy can hope to be successful unless it takes into account the fact that a person's visual perceptions of reality depend in part upon the fact that he receives but not one but two sets of impressions of the outside world. Each of these impressions is in itself clear and distinct, and has its own geometric perspective differing from that of the other impression because of the distance apart of this hypothetical observer's eyes.

In general, the appearance of the pictures as a reality rather than as an illusion is probably most satisfactory when the normal condition of viewing is rigorously observed. It does not follow from the fact that a separation of 2½ inches in taking the pictures produces a result far more pleasing than a single

picture, that therefore two or three times normal intercular separation in taking the pictures would lead to an effect two or three times as pleasing. For photographers who do not understand in detail the geometry of stereoscopic photography and viewing, the safe rule is to use normal eye separation in taking.

Serious work in stereoscopic photography has developed into two general technics, each of which is based upon the general idea that each eye must see its own picture and only its own picture.

Parallax Panoramagrams

One general type of device for stereoscopic viewing makes use of the difference in direction from which the two eyes see the picture. Ives has given this method of attack much serious thought and has done the outstanding work in this field. A result has been the parallax panoramagrams now seen often in drugstores and department store windows. The device depends for its success upon taking a picture from a series of positions in an arc around the object and showing these so shielded by a vertical grid that the observer's right eye sees a series of vertical strips composing the right-eye picture only and his left eye sees another series composing only the left-eye picture.

Certain viewing positions for this type of work are unsuitable, and taking the pictures is difficult. Registration of the strips in such a pattern must be extremely accurate, and it is difficult to get the required detail for each picture. All these considerations militate against its ever being of broad commercial usefulness. Objects can be photographed in the laboratory and shown there, however, and the results stand as a testimonial to Ives' careful work and to his ingenuity.

The second general technic of stereoscopic reproduction involves the use of filters so chosen that with a stereoscopic pair of pictures made visible respectively in two kinds of light, each eye sees only the picture intended for it. This method divides into the use of complementary colors and the use of polarization. Using red and green glasses, Norling and Leventhal have produced the extremely entertaining series of pictures known to the public as "audioscopics."

In France, Lumiere, of color-plate fame, utilized two colors (in his case yellow and blue) to produce stereoscopy in motion pictures. It seems that the possibilities of this type of showing have been pretty thoroughly exploited. The disadvantages are three: (1) When two colors are used to produce stereoscopy, there is bound to be retinal rivalry between the eyes, especially in viewing large, clear areas such as of the sky or water; and it is doubtful whether long pres-

(*Continued on page* 32)

THE PRESENT STATUS OF THE H. I. MERCURY ARC

VERY intense arcs have been laboratory realities for some time. Discovery of a law relating power to light given by the high-intensity mercury arc brings the general commercial use of very high-power mercury arcs one step nearer, according to a recent paper[1] by Dr. J. W. Marden, assistant director of research of the Westinghouse Lamp Works. The following excerpts from this paper should prove very interesting to those who have speculated upon the progress being made with this new light source:

"After years of intensive study we have discovered that there is a logarithmic relationship between the candlepower per unit volume and the watts per unit volume of the arc stream. In addition, we have found that a constant ratio between watts per centimeter and lumens per centimeter enables us to progress one step further and determine a maximum expected efficiency for this type of lamp of from 60 to 90 lumens per watt.

"Thus, from measurements of the arc stream in lamps already in practical laboratory application, it is possible to determine the wattage required to operate mercury arc lamps of any desired per-unit brightness, and at the same time to simplify the study of materials which has as its object the production of a lamp capable of withstanding the abnormal pressure 1100 pounds per square inch, three times that of the steam in a locomotive, and the extreme temperature of 14,000 degrees, hotter than the surface of the sun.

[1] "A Mercury Arc as Bright as the Sun," read before the Illuminating Engineering Society 31st Convention at White Sulphur Springs, W. Va., Sept. 27-30.

TABLE I	Candle-power per cm.
100-w. mercury lamp in double glass housing	80
Commercial 250-w. high intensity glass lamp	100
Commercial 400-w. h. i. glass lamp in outer housing	100
Large 2000-w. quartz lamp, stagnant air	400
Quartz lamp 350 watts, air blast cooling	900
Commercial 85-w. quartz	1900
750-w. tungsten bi-plane filament	2400
Quartz mercury arc, magnetic field to control arc stream	8400
Quartz mercury arc, vertical burning, air cooling	10000
Quartz mercury arc with air blast cooling	16000
Water-cooled quartz mercury arc	20000
Water-cooled mercury arc No. 2	21000
Carbon arc	45000
Water-cooled quartz mercury arc lamp	70000
Beck arc	110000
Sun	165000
Elenbaas super-pressure quartz mercury arc lamp (max.)	180000
High pressure carbon arc	280000

Light Intensities Compared

"In recent studies, light intensities of various types of lamps were measured at right angles to the axis of the arc stream by means of a calibrated photronic cell which had approximately the sensitivity of the eye. The readings were taken in terms of lumens, candlepower per cm., or per cu. cm. of arc stream. The length and diameter of the arc streams were in most cases determined by projecting the magnified image on a screen for direct measurement. The distribution of the intensity across the arc streams was determined by recording the energy passing through a narrow slit fastened on the face of the photronic cell. This unit can be moved across the projected image of the arc stream by means of a micrometer screw.

The accompanying table records readings made on various lamps. It also includes data collected by Elenbaas and other investigators. Some of the mercury lamps were operated within an outer glass housing, others had none. Cooling was with stagnant air, air-blast and with water. The assigned values are average over the area of the arc stream.

"As the table shows, the brightnesses of the present highly efficient commercial mercury arcs do not even equal those of the biplane filament lamp. Under extreme conditions, however, the brightness of the sun can be attained either with specially designed mercury arcs, or with carbon arcs.

"Figure 1 is a good example of a high-intensity experimental mercury arc lamp designed to be cooled by cold water rapidly run through the outer glass jacket of the lamp. The tiny black square in the middle of the lamp is a cylinder of mercury in the bore of the tube where the arc takes place. This arc space is about a tenth of an inch in diameter and less than half an inch long in this particular specimen. In this restricted space almost two kilowatts of electrical energy can be turned into light and heat. It is evident that with such great energy forced into such a small

WARNER BROS.
STANLEY THEATRE
...ONE OF THE MANY
Warner Theatres
IN PHILADELPHIA
which gives its patrons
the finest in sound
with RCA
MAGIC VOICE
OF THE **SCREEN**

You Can do it, Too!

RCA Photophone equipment is available for all theatres—from smallest to largest—at prices to suit your own requirements!

RCA Photophone—The Magic Voice of the Screen—is the finest motion picture sound equipment in the world! Because it's made by the world's leading sound organization—RCA—and profits by RCA experience in sound recording at 10 movie studios.

Only Photophone offers you these 10 *proofs* of its superiority! Rotary Stabilizer... Cellular Speakers ...Low Cost Maintenance, Liberal Service... Simple Operation... Economical Operation ... Push-Pull Adaptability... High Fidelity Reproduction ... Simple Installation ... Accessibility ... Sole Ownership

This equipment means better sound for your theatre—sound that matches the Stanley's. Better sound means better box-office. That's why RCA Photophone is a "sound" investment!

RCA *Photophone*

THE MAGIC VOICE OF THE SCREEN

MAGIC VOICE of the SCREEN

RCA MANUFACTURING CO., INC., CAMDEN, N. J. • A SERVICE OF RADIO CORPORATION OF AMERICA

Buy G-M Photocells from YOUR DEALER

VISITRON PHOTOCELLS

Your dealer is organized to give quick, convenient, complete service on all kinds of high quality projection equipment.

THAT IS WHY he handles Visitron Photocells. That is why you should order those photocells from him.

Remember that your dealer cooperates with G-M Laboratories to give you maximum photocell service. G-M manufactures photocells with care and precision to make sure they will give you perfect reproduction. The dealer keeps them ready at hand and makes prompt delivery so you can have a Visitron Cell whenever you need one.

Look for the G-M monogram

G-M LABORATORIES INC.

1731 BELMONT AVE., Dept. K, CHICAGO, U. S. A.

FIGURE 1

arc stream, creating high pressures and temperatures, the difficulties in manufacturing these devices are at present great. A mercury lamp having an arc stream with a brightness approximating that of the sun, even at the most intense point, is as yet only in the laboratory experimental stage.

Possible Projection Application

"Because of its inherent properties, the water-cooled quartz mercury lamp may indeed supply the motion picture industry with a perfect projection lamp. The possibilities of its application to the problems of floodlighting and headlighting, the latter in particular for locomotives, are significant. It is perhaps not unlikely that this type of lamp will play an important role in anti-aircraft protection of the future, when improved searchlights will be able to throw powerful beams into the farthest reaches of the night. Warships, too, may find it a useful weapon against fog, and even enemy smoke screens.

"To summarize, we can now make an air-cooled lamp, the intrinsic brilliance of which is about four times that obtainable with a standard biplane filament projection lamp. A water-cooled mercury arc of a variety which at present is comparatively easy to produce and operate, is capable of intensities in the arc stream of eight or ten times that of the tungsten filament lamp."

CHRISTMAS SEALS—AND THE UNCEASING WAR ON THE DREADED 'WHITE PLAGUE'

By *ANN HOLLINSHEAD*

Each year at this time it is our privilege and pleasure, if not our duty in behalf of the craft, to open our pages to the editorial and advertising copy of the National Tuberculosis Association, which wages an unceasing war on tuberculosis. Association activities are financed through the sales of Christmas Seals, a tiny bit of colored paper that is slowly but surely conquering tuberculosis. High hopes are entertained for the ultimate eradication of this dread scourge of mankind—provided more widespread support is given to the Christmas Seal.

Pulmonary ailments are a definite occupational hazard of projection work—and many members of the craft have benefited by the Association's activities. Therefore, we owe it to ourselves, at least, to extend the meager aid asked by the Association —the purchase of Christmas Seals.—J. J. F.

THE physician looked up from the large negative on his desk and into the face of the young man beside him. "It's tuberculosis all right. Early stages, though, so you've got a good chance. But *where* did you get it?"

That same question, in much the same setting, is being asked of patients throughout this country at least once every five minutes. At that shocking rate physicians in the United States are still diagnosing patients as tuberculous, and putting that searching question to each one of them—"*Where* did you get it?"

For tuberculosis is now known to be a contact disease—a disease caused by a microscopic organism and passed on to others through the sputum and nasal discharges of the sick. Everyone who contracts it has been in association with someone who has it. No one can possibly get it in any other way. Separate the sick from the well, say our leading tuberculosis specialists, and the disease will at last be conquered.

From its insidious nature, however, the sick do not always know that they are sick. Here, then, is the first task of the health educator—to make people aware of the four danger signs of tuberculosis, namely the persistent cough, unexplainable fatigue, loss of weight and indigestion.

"I wish I'd known what to do now," is the lament of thousands of patients in sanatoria today, as they recall some friend or sweetheart who showed these early symptoms but who thought nothing of them. "If Bill had gone to the doctor when I begged him to, I myself would not be spending these long mattress years here," says Bill's wife in many a sanatorium where she is lying on her back, curing of tuberculosis. She has learned the nature of the disease and the fact that with close contact, infection is inevitable.

Many Unsuspected Contacts

The following true story is told by the superintendent of one of our largest tuberculosis sanatoria. Dramatically it warns us all of the need for constantly being on our guard against this age-old destroyer of human life. A child of four years died of tuberculosis recently and the health authorities in an effort to locate the source of infection, examined every member of the immediate family as well as all relatives in the larger family circle, a total of thirty-five people. But not one of them was found to have the disease. The authorities were much perplexed until reports came to them that three other young children living in the same beautiful apartment buildings had been diagnosed by their physicians as being in the early stages of tuberculosis. Here was a clue that might lead to the contact. Someone with tuberculosis must have been in close touch with all of these young children. After careful and tactful investigation, that someone proved to be the motherly unmarried woman in her late forties who was always willing to care for other people's children when pressing errands or bridge parties called their parents away. Apparently hale and hearty, no one but a physician with an X-ray machine would have suspected her. But actually the X-ray film showed her to have a far-advanced tuberculosis of both lungs.

In a recent editorial in *Hygeia*, popular health publication of the American Medical Association, Dr. W. W. Bauer warns us that in spite of the progress made in the last thirty years when tuberculosis has been brought from the leading cause of death down to seventh place, our battle from now on will be "harder and slower because the stiffest part is ahead." Discovering tuberculosis cases and *preventing contact* with them is more than ever of first importance. Hidden sources of infection must be found before we can ever hope to be completely successful.

True, the medical profession has every means in its possession today for diagnosing cases of tuberculosis—the tuberculin test, the fluroscope and the X-ray, all widely used by modern doctors everywhere. But doctors can do little or nothing without the active cooperation of the average man and woman.

It is this average man and woman who must be better informed about tuber-

(*Continued on page* 31)

TYPICAL TROUBLES IN MODERN SOUND REPRODUCING UNITS

By *LEROY CHADBOURNE*

VI.

INCLUDED in our list of unusual reproduction troubles is a case of erratic and unpredictable changes in volume. The theatre in question changed programs from two to four times a week, depending on the type of picture. During the first showing of each program the manager stationed himself at the back of the auditorium, alongside the sound buzzer, and cued the picture. The projectionist watched the screen and noted every change of scene that called for a change in sound volume, according to the opinion of the manager. The cue sheet prepared in this way governed all subsequent performances of that program.

A new sound system was installed, including low- and high-frequency speakers, which, however, were equipped not with multi-cellular horns but with directional-type baffles. Distribution was checked with exceptional care by the manager; he spent considerable time walking about the house until he was confident he could judge the sound accurately from his favorite listening post alongside the projection room buzzer. As often happens in such cases, initial enthusiasm over the new system led to expenditures in excess of the budget, and therefore to a sudden splurge of economy at the tail end of the job. For one thing, the fine new speakers were hung with manilla rope instead of chains, because the old chains were much too short and the cost of buying new ones could be saved by using some old rope that was lying around. Also, a substantial percentage of the old wiring was used, to avoid the expense of running new lines.

Considerable work was done in the projection room, after installation, to find why the new system failed to "hold volume". For the manager, after cuing his shows as usual, would occasionally come down from the office to his favorite listening spot and fail to hear the sound. The projectionists proceeded to tear the new system apart. The most difficult angle of the trouble was its inconstancy; for days at a time, sometimes for a week or more, the equipment behaved perfectly; then for a day, or perhaps for several days, the cuing would prove entirely unreliable. This irregularity complicated trouble-shooting operations; and the condition endured for more than two months.

All meter readings were normal at all times. Changing tubes made no difference. Change-over between projectors had no effect. It was noted that monitor volume seemed constant at all times; this was checked by headphones, which also seemed unaffected by the irregularities reported. A volume indicator and test reel were obtained, and gain runs were taken, first, on a day when volume was normal, and then on a day when it was not. Projection room performance was identical on both occasions.

It was then thought that possibly the speaker field excitation might be varying, and (since this could not satisfactorily be tested in the projection room) arrangements were made for a third member of the staff to come to the theatre during show time to read speaker exciting voltage backstage, both when the trouble was present and when it was not. This procedure disclosed the real trouble even though the field excitation proved to be okay.

Having already checked field voltage when the sound was normal, this projectionist returned another day when the trouble reappeared. Walking down a side aisle toward the screen, he was struck by the fact that the volume semed high, not low. Excitation voltage proved normal. The high volume found was reported to the manager, who, checking at his favorite listening post, found that the volume was low! The distribution had gone wrong. Speakers were inspected, but all the ropes were in place and taut —very taut. Nothing more was done at the time because of another trouble (described hereinafter) which needed more immediate attention.

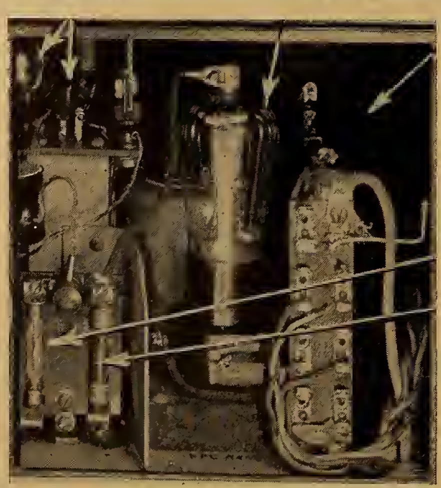


FIGURE 1
Resistors are indicated by arrows pointing to lower left corner

Just One of Those Things

Later, the speakers were inspected at a time when sound distribution was satisfactory, and the guy ropes were found less tight than before. The long ropes were contracting and expanding with changes in the moisture content of the atmosphere, thus altering the setting of the directional speakers. The resultant changes in distribution were misinterpreted as changes in volume because the manager checked sound from one point only. Installing chains instead of ropes put a permanent end to the trouble.

The same unwise economy that led to the use of ropes instead of chains was responsible for another trouble in the projection room of the same theatre. This was a crackling noise, irregular in appearance and extremely annoying. The trouble appeared shortly after installation. Because of its erratic nature, several days of checking were necessary to prove that it appeared only when No. 1 projector was in operation. The new photocells were interchanged, but without results. Interchanging the p.e.c. amplifier tubes proved equally futile. It then appeared likely that the fault lie in the new head amplifier, but when this was checked by interchanging the amplifiers the noise still remained in No. 1 only.

A 1,000-ohm-per-volt vôltmeter was connected to the plate supply of No. 1 p.e.c. and its amplifier. When next the noise was reported, its presence was checked by headphones (connected in parallel to the monitor) and the meter was observed simultaneously. Meter fluctuation in synchronism with the disturbance would have indicted the power supply, but this test also showed nothing: the meter needle stood motionless even while the crackling was loudest.

Power supply, photo-cell, amplifier and amplifier tube having thus been cleared, it was determined to inspect the fader for a possible poor connection in the No. 1 input circuits. Nothing was found. To double-check on this, input connections were interchanged, No. 1 projector now

going to No. 2 input terminal, and *vice versa*. The noise now appeared only when the fader was set at No. 2—that is, when, as before, sound originated in No. 1.

Prove Cable at Fault

An attempt was then made to check the connecting cable by applying the headphones to the fader input and to No. 1 output. This test failed to work: neither sound nor noise could be heard at either location, the phones being insufficiently sensitive. After some thought, another method of testing the cable was devised. Fader input connections had already been reversed. The physical arrangement of the conduits made it possible to interchange cables at the projector end, and the new fader connections were left as they were. When the noise next reappeared it was in No. 2, and No. 1 remained clear of trouble, proving that the cable was at fault.

New cables, a lead-covered pair, were obtained, and the old ones pulled out. Left over from the original installation, they had been used with the new system for the sake of economy. The expense incurred looking for this trouble would have paid for a new cable a dozen times over. However, the old cables should not have given trouble, and never would have, if they hadn't been spliced to start with. This was a violation of good practice dating back to the first days of sound, which nevertheless had caused no trouble for years because the splices had never been disturbed. When, in the course of the new installation, other wires had been pulled out of the same conduit and new ones pulled in, the splice in the No. 1 speech output cable suffered enough damage to make the connection imperfect.

A sound engineer on the wrong track was steered right by a projectionist in another case of sound trouble also associated with one projector only. This was in modern equipment then somewhat more than a year old and undergoing its first thorough check-up. A test reel gain run showed a striking difference in quality between two projectors, one of which was entirely satisfactory while the other was decidedly poor at high frequencies. After repeating the test to make sure, the engineer asked the projectionist to interchange optical trains. In the sound heads in question this job was somewhat difficult, and the projectionist was reluctant to tackle it. He insisted the fault lie in the "grid leaks" —that is, the resistors coupling the p.e.c. to the input of the head amplifier (Fig. 1). But these resistors carry practically no current; they sometimes become noisy but seldom change value, and the engineer found it hard to believe that they had changed enough to account for the results he found.

Incorrect Resistor Rating

The projectionist insisted, however, the engineer agreed to the change, and the trouble vanished. Then the truth came out. Careful inspection, and some cleaning, of the replaced resistors made it possible to read their rating marks. Those in the defective projector were of the wrong rating. How could that happen? Well, one of the crew, trying to eliminate a noise, had replaced grid leaks in that machine and used the wrong replacements. The incident was not reported, the new grid leaks had been overlooked on subsequent inspections, and for an unknown number of months the projector had been running with improper equipment and delivering sound of 1928 quality. The projectionist who corrected the engineer knew all about it, but said nothing about it until it appeared that discovery was certain.

Investigation of another case of poor sound uncovered a mechanical trouble which, if unchecked, might possibly have ended in serious damage to both sound head and projector. As in the previous incident, the existence of trouble was uncovered by a standard gain run which showed one projector to be deficient in high - frequency response. The fact that the machine was somewhat noisy in operation led to a suspicion of flutter as the cause. Careful listening in the auditorium confirmed this hypothesis, despite the fact that the management had made no complaint.

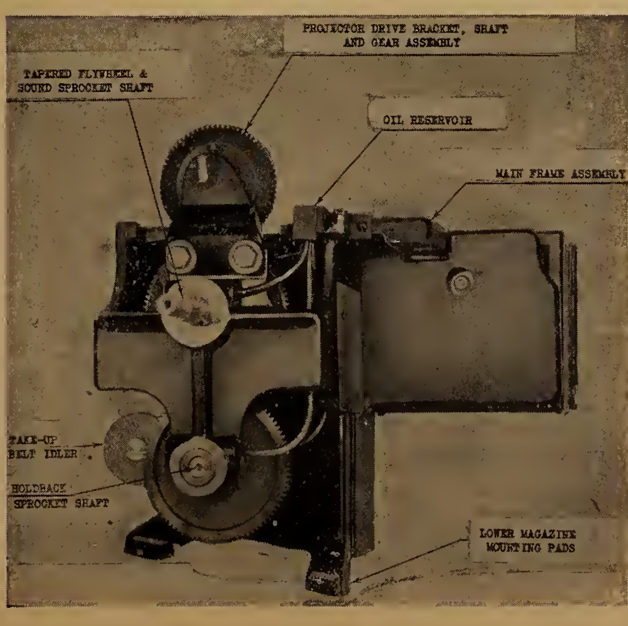


FIGURE 2

The character of the noise made by the projector seemed to eliminate the take-up as a possible source of the trouble and indicated, instead, either some defect in the projector, misalignment with the sound head or, possibly, a defective gear in the latter. Fig. 2 illustrates a sound head similar to the one in question. There are a number of related types and most projectionists are familiar with them. At the top of the illustration is the fibre gear which forms the mechanical link between sound head and projector and transmits the driving power to the latter. Directly in front of this gear is the elbow-shaped oil shaft, or "floating shaft," which has often developed new resources in projectionist profanity.

For the benefit of those unfamiliar with the arrangement, it should be explained that the projector head, missing from Fig. 2, fits just behind the fiber gear. The elbow-shaped shaft, about eight inches long, penetrates the triangular yoke shown in the illustration, then the center of the fibre gear, and then the projector itself. The arrangement requires highly accurate alignment, the projector being shifted on its mounting (the top of the sound head), until the shaft can be inserted or removed without using force and without appreciable friction. Once the correct position for the projector head is found, it is locked there by means of two holding bolts, and very seldom shifts.

In the present instance, noisy operation and the existence of flutter suggested that the projector might have shifted slightly out of place. The flywheel and protective guard, not seen in Fig. 2, were removed, leaving the sound head stripped down as shown. The setscrew at the apex of the triangular yoke was loosened, after which the elbow-shaped shaft should pull out easily. The fact that pliers were needed to get it out foretold the answer—it was found sprung.

Defective Hidden Machinery

In preparation for realignment and substitution of a new shaft the triangular yoke was loosened. It is held in place, as shown, by the two bolts at the bottom which screw into threaded holes in the sound head casting. (The yoke of the head under discussion was slightly different in shape from the one in the picture). These bolts came out with suspicious ease; the one at the right, in fact, seemed hardly to be holding at all. It wasn't. Inspection showed that while the threads of the bolts were good, those in the casting were practically use-

less. The right-hand thread was stripped entirely; the other had no more than one turn left. These bolts were made up with unnecessary force and were hardly holding at all. A complete bind-up was averted only by the single turn still remaining in the left-hand hole.

Slightly larger bolts were obtained, the sound head casting was drilled out and re-tapped, a new and straight shaft was substituted, and the projector head was loosened in place and realigned. Some small damage had evidently been done to the projector, as some of the noise of operation and a small portion of the flutter still remained. Inasmuch as the head is slated for factory overhaul in the near future, further effort at clearing up these difficulties was deferred.

Lead-covered cable of the common type mentioned previously proved to be the cause of a comparatively simple case of sound outage in an installation some two or three years old. Whether the cable itself was older, having been held over from a previous installation, seemed probable from its appearance. In the common form of these cables, as everyone knows, the solid No. 19 wires are surrounded by rubber insulation, which in turn is surrounded by the lead sheath. The projection room walls in this theatre were sheet-rock mounted on angle-iron. The amplifier was bolted between two of the angle-iron struts.

Sound outage occurred suddenly and was apparently cured by the random replacement of a tube in the amplifier. An hour later sound went out again, and installing still another tube in the same socket failed to help. Click test for sound applied to the other projector was not heard, eliminating the projectors from further consideration. The amplifier was then checked more intelligently by the simple process of flipping a finger-nail against the first tube. The resultant sound was heard in the monitor, eliminating the amplifier and the speakers, and confining the trouble to the amplifier input, fader output, or the cable between the two.

The tube that had been removed from the amplifier an hour earlier was then reinstalled, and the finger-nail test repeated. The same ringing sound was heard, indicating that the tube was not defective, but that there was some open or short circuit in the amplifier itself which had been adjusted temporarily by the slight jarring of replacing a tube in apparatus mounted on a shaky wall. One projectionist turned to the nearest projector and applied a click test for sound continuously, while the other man struck the wall repeatedly with his fist. Under these conditions the sound of the click test was heard now and then, confirming the suspicion of trouble at the amplifier input.

Inspection there showed that the lead sheath has been stripped back during installation about ten inches from the ends of the wires. Ten inches of rubber-covered No. 19 were exposed, and the rubber had cracked through age or other cause, leaving gaps of exposed copper as much as 1/16 inch long. Apparently one of these gaps had grounded or shorted the input circuit; at any rate, the click tests were heard continuously as soon as the projectionist pulled the wires toward him to examine them. Had the amplifier been more solidly mounted these wires probably would not have shifted position, and the same cracks in the rubber might have done no harm at all. Rubber and friction tape constituted a permanent cure.

A flagrant case of poor trouble work concerns repeated occurrences of line frequency hum which was traced to a modernized amplifier still using the older type, "bayonet" sockets. The hum disappeared when the tubes were taken out and their prongs cleaned with Carbona. On its second appearance the same trouble was eliminated by taking out the tubes, cleaning them as before, and also cleaning the socket prongs with the eraser on the back of a pencil. On the third occasion neither remedy sufficed until new tubes were installed.

When the trouble appeared for the fourth time (in as many weeks) the back of the amplifier was opened and the sockets inspected. Scrapes and abrasions were seen all over the backs of the socket prongs. The side edges of some of them were actually "chewed up." Unquestionably the same sockets had caused hum in the past, and someone tried to improve contact with a screwdriver! There can be no permanent remedy now other than new sockets.

Front view of the two loudspeaker systems used for Stereophonic reproduction. This is an experimental setup and differs from the regular theatre installation in which the two h. f. multi-cellular horn units would be placed further above the l. f. units than is shown here.

NOTES ON ERPI'S STEREOPHONIC SOUND PICTURE SYSTEM

RECENT demonstrations by Erpi of its Stereophonic, or "three-dimensional," sound recording and reproduction system, having been confined almost exclusively to the Metropolitan New York City area, have elicited numerous inquiries from the field as to its nature and potentialities. This brief presentation, including the accompanying illustrations, is an attempt to convey such information regarding this new system as has been made available to date.

The Stereophonic system is an attempt to "localize" the sound, that is, to have the dialogue and sound effects emanate directly from the point of origin on the motion picture screen. In such a demonstration, a ping pong game is shown on the screen and the sound of the bouncing ball follows the exact path of the ball itself. So accurate was the "sound path" of the ball as it traveled from one side of the net to the other, it was easily possible to close the eyes and tell at any instant which side of the net the ball happened to hit. At one point of the game, the player missed the ball and it bounced off the table and disappeared behind the player. The *sound* of the bouncing ball likewise went to the floor and appeared to recede beyond the line of vision on the screen.

"In present-day sound pictures we obtain only an illusion of sound coming

Behind-the-screen view of experimental Stereophonic theatre speaker system. Two complete speaker systems are usually seen. Above is not a finished theatre job

from the point of origin on the screen," said Mr. J. P. Maxfield, of Erpi, who figured prominently in the development of this new system. "Actually, it comes from a fixed point behind the centre of the screen with no direction or space-relationship. If, for instance, we see someone playing a piano on the screen, our ears and our eyes tell us that the sound of the piano is coming from the *keyboard* of the piano because we see the pianist strike the keys. There is no effect of sound motion on the screen. Stereophonic recording and reproduction provides this sound motion or direction.

"The reel of Stereophonic recordings demonstrate this effect. In one sequence a woman plays a short piano selection, and the notes of the piano actually come from the strings behind the keyboard, and the *distance* between the bass and treble strings is easily discerned. In another scene a large symphony orchestra plays. The location of the choirs or individual musicians in the orchestra is easily discerned by the sound coming directly from each instrument.

"A short skit is also presented which opens with a darkened screen. A clock is heard striking and the audience involuntarily looks to the right of the screen to see it. A telephone rings and the audience looks to the opposite side to see it. When the lights come up revealing a living room set, the clock and telephone are in the exact positions in which the audience had looked.

Two Channels and Double Track

"In ordinary sound pictures of today, sound is picked up with one microphone amplifier channel and recorded on only one sound track. The condition is actually similar to hearing with only one ear. In the Stereophonic system, sound is picked up by two channels and *the output of each is recorded on a separate sound track on the film.* In other words, there are two separate sound tracks on

Note double track of Stereophonic recording. (Note: Position of track is the engraver's idea, not ours.—Ed.)

the film each of which is a recording of just one channel. In reproducing the two sound tracks in the theatre, the output of each track is fed to a separate set of loud-speakers at the sides of the screen. The effect on the listener is that he is actually enjoying 'two-ear hearing' (binaural) instead of 'one-ear hearing.'

"How soon Stereophonic recording will be incorporated in regular production is a matter that rests with the production companies. Ultimate naturalness in talking pictures will be accomplished only when color, stereoscopic photography, and stereophonic recording are combined and presented together in the motion picture."

Comparative Operating Costs of Low-Intensity SRA and Suprex Carbons

(Power data was computed on the basis of source of average efficiency)

TRIM	Arc Amps.	Arc Volts	Inches Consumed per Hr.	Aver. Stub. Inches	Aver. Carbon Life Hours	* Net Price per Carbon	*Carbon Cost per Hour	POWER DATA Arc Watts	Effic. Line to Arc	Line Watts	Power Cost per Hour @ 2¢	@ 4¢	Total Arc Cost per Hour @ 2¢	@ 4¢	Approx. Lumens on Screen	Relative Amount Screen Light
SRA																
12mm. x 8"	32	55	2.76	1¾	2.26	$.049	$.0217									
8mm. x 8"			2.45	1¼	2.75	.056	.0203									
							.0420	1760	48%	3670	$.0734	$.1468	$.1154	$.1888	2300	100
"SUPREX"																
6mm. x 12"	40	34	9.99	2½	.95	.1086	.1144									
5mm. x 9"			4.58	2½	1.42	.042	.0296									
							.1440	1360	60%	2265	.0453	.0906	.1893	.2346	3100	135
7mm. x 12"	45	34	8.8	2½	1.08	.112	.1036									
6mm. x 9"			3.7	2½	1.76	.063	.0358									
							.1394	1530	60%	2525	.0505	.101	.1899	.2404	4500	195
8mm. x 12"	60	33	8.0	2½	1.19	.119	.100									
6.5mm. x 9"			4.2	2½	1.55	.0644	.042									
							.142	1980	60%	3300	.066	.132	.208	.274	5300	230
8mm. x 12"	65	37	11.07	2½	.86	.119	.1385									
7mm. x 9"			3.66	2½	1.77	.0666	.0377									
							.1762	2405	60%	4000	.080	.160	.256	.336	6200	270

AN OUTLINE OF TUBE TYPES USED IN MODERN SOUND PICTURE AMPLIFIERS

By *WILLIAM STERLING*

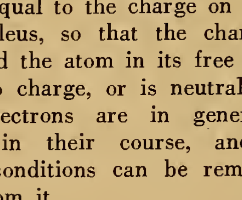
MATTER exists in solid, liquid or gaseous state. These three forms of matter are composed of molecules, which are the smallest physical divisions possible without destroying the identity of the matter. Molecules, in turn, are composed of atoms, these atoms having a nucleus built up of both positive and negative charges but with an excess of positive charges, or protons, thus giving the nucleus a positive charge. About this nucleus moving in a planetary elliptical orbit, revolve negative particles of electricity, called electrons.

There are several orbits of varying radii within each atom. The sum of the negative charges of these electrons is always equal to the charge on the positive nucleus, so that the charges balance, and the atom in its free state exhibits no charge, or is neutral. These outer electrons are in general held loosely in their course, and under proper conditions can be removed entirely from it.

Cathode and Plate Functions

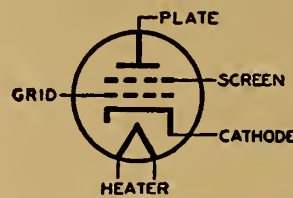
The activity of electrons is increased by heat, and if a metallic conductor is heated sufficiently by the passage of an electric current through it, some electrons will break away from the surface and be set free in space. If no other attraction for these free electrons is present, they will return to the heated conductor, because when they first left it created a deficiency of negative particles (electrons), thereby giving the conductor a positive charge. It should be remembered that like charges repel, and unlike charges attract.

By placing this heated conductor



Triode Type

(electron emitter or cathode, as it is called) in a vacuum, combustion of the conductor is prevented and the emission of the electrons is not retarded by air resistance. By placing within this vacuum tube a metal plate having a positive charge placed on it, the dislodged electrons are attracted to the plate. This plate may be raised to a positive potential by a battery, or a generator or by any other suitable method. The nega-



Tetrode Type

tive pole of this plate source is connected to the electron emitter, or cathode, thus completing the plate supply circuit through the stream of electrons within the vacuum tube. This flow of current constitutes the plate current, and a suitable meter placed in this circuit will indicate the current flowing.

If the voltage supply to the plate be reversed, so that the plate has a negative potential placed on it, the electrons from the cathode will be repelled, and no current will flow through the plate circuit. If, therefore, a source of voltage which periodically changes from a negative to a positive value is supplied to the plate, current will flow only when the plate is positive, and will cease to flow when the plate becomes negative.

Thus, a two-element tube can be employed to change an alternating voltage to a voltage flowing in one direction, or direct current. This class of tubes, employing two elements, are known as diodes.

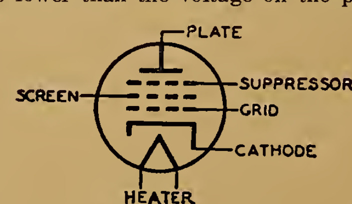
The placement of a wire-mesh electrode, or grid, between the cathode and plate, and the placement of a negative voltage on this third electrode, will repel the electrons thrown from the emitter to a greater or lesser degree, depending upon the charge on the grid. The more the grid repels the electrons the fewer electrons will reach the plate, and, therefore, the less will be the plate current. By the same reasoning, if a positive charge is placed on the grid, it will attract the electrons, and due to the open structure of the grid will accelerate them toward the plate, which always is at a higher potential than the grid. As this grid is always placed much closer to the cathode than to the plate, any variations in the grid voltage will produce similar variations in the plate voltage —but on an amplified scale. If the grid is made increasingly negative, a point is reached where it repels all the electrons arising from the cathode, thus reducing the plate current to zero. This value of grid voltage is called the cut-off bias.

If, therefore, a voltage of varying intensity, such as the output of a microphone or photo-electric cell, is impressed on the grid and cathode, generally called the input circuit, an almost exact reproduction of these variations will be reproduced in the plate circuit —but on an amplified scale. The plate and cathode circuit are referred to as the output circuit.

By means of suitable coupling devices, the amplified output may be fed to the grid of another similar tube and further amplified. This process may be repeated to certain limits, until the output voltage is enough to operate any desired device, such as a loudspeaker. Tubes of this class employing three elements or electrodes, are known as triodes.

Introduction of Screen Grid

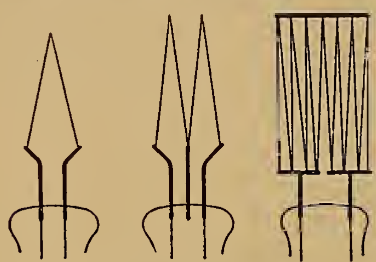
The grid and the plate, being two parallel metal surfaces, act as a very small condenser, and in some circuits this small capacity between the electrodes is enough to couple the input and output circuits and thereby cause feedback or regeneration. This is reproduced in the speaker as distortion. To correct this, another electrode is placed within the tube, close to but not touching the plate. This new electrode is similar in appearance and construction to the grid, and is connected to a source of positive voltage lower than the voltage on the plate.



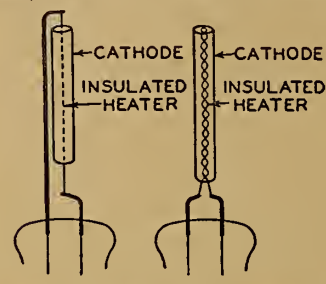
Pentode Type

While this fourth electrode, known as the screen grid, can attract the electrons toward and through it to the plate, it also acts as an electrostatic shield between the first, or control, grid and the

plate. This screen reduces the capacity between the control grid and the plate to a very small amount, small enough to prevent troublesome coupling. Tubes



DIRECTLY-HEATED CATHODES
(FILAMENT TYPE)



INDIRECTLY-HEATED CATHODES
(HEATER TYPE)

ot this class, employing four electrodes, are known as tetrodes.

The dislodgement of electrons from the cathode is a product of the temperature to which the cathode is raised. This type of emission is known as thermionic emission. However, another type of emission may occur. When the electrons strike the plate their enormous velocity causes more electrons to become dislodged from the plate itself. This is known as secondary emission. In the triode these stray electrons do little harm, as they are soon drawn back to the plate. In the screen grid, or tetrode type, however, the positive screen being so close to the plate, these stray electrons will also be drawn to the screen, more strongly so when the plate voltage swings below that of the screen voltage. The effect will be to cut off the plate current, which will result in distortion in the reproducer.

Now, by placing still another grid-like structure between the suppressor grid and the plate, and connecting this new grid to the cathode, the new grid will have a negative potential on it with respect to the plate. Any stray electrons that have been dislodged from the plate by impact are now repelled by the negative suppressor and are forced to return to the plate. This, of course, prevents them from reaching the screen grid. These tubes, having five elements, or electrodes, are classed as pentodes.

[NOTE: Questions arising from or suggested by the foregoing article are invited and will be answered in the next issue.—ED.]

A SIMPLE BRIGHTNESS METER

BRIGHTNESS and brightness contrasts are the most generally important among the fundamental factors affecting visibility. This is recognized in research, but not in everyday seeing as is evidenced by the lack of available brightness meters. Luckiesh and Taylor[1] have recently described a refined brightness meter having the enormous range of 25,000,000 to 1 with the accuracy and convenience desirable for a vast variety of refined measurements wherever absolute brightness is important.

The instrument described in the present note is illustrative of extreme simplicity with some sacrifice in convenience. Its range can be as great as is necessary. It measures relative brightness and brightness contrasts and depends upon any available footcandle meter to convert relative brightness into absolute brightness. The simple form described involves a fundamental principle which can take many physical forms besides the one actually illustrated (Fig. 1).

One tube of the device has a lens *L* in the end which, in combination with the adjustable eye-piece *E*, is practically a telescope of universal focus. The instrument is so sighted that the image of the object whose brightness *C* to be measured is seen in the central portion of the photometric field surrounded by a mirrored portion. In the end of the other tube is a perfectly diffusing translucent glass. Its brightness *O* is proportional to the footcandles upon it, and its brightness is seen in the mirrored portion of the photometric field. Thus *O* provides the comparison brightness.

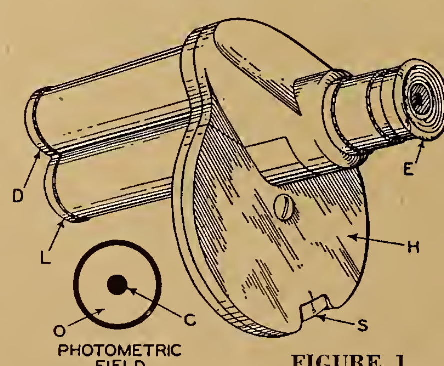


FIGURE 1

Determinations of relative brightness are readily convertible into absolute brightness with the aid of any footcandle meter by measuring the footcandles on the diffusing glass, D

The brightness of the object focused is varied by means of a circular gradient of extensive range in transmission factor which is enclosed in the housing *H*. Thus a setting is made and the relative brightness of the object is read from the scale *S*.

Suppose the relative brightnesses of the envelope of diffusing glass of a common office lighting fixture and that of the ceiling surrounding it are to be determined. The foregoing procedure is applied first to the bright portion of the fixture and then to the adjacent ceiling. In both cases the illumination in footcandles upon the diffusing glass *D*, and hence its brightness, remain sensibly the same. Thus *D* is a constant comparison field for the determination of relative brightnesses of the fixture and ceiling and the brightness contrast, which is an important factor in visibility and comfort. Inasmuch as the brightness of *D* depends upon its illumination, a simple measurement of the footcandles received by *D* provides a means of conversion (with the aid of a predetermined constant for the instrument) of relative into absolute brightness. With the increasing use and availability of inexpensive footcandle meters such a simple brightness meter should eventually serve many practical purposes.

Many Diverse Applications

The actual range in brightness obtainable by the gradient alone is of the order of 2,000 to 1. Reducing and multiplying screens can be inserted to extend the range. These are incorporated in the instrument on the side not shown in the illustration. If screens having transmission factors of 10% and 1% are arranged to be readily inserted on either side of the photometric field, the range is extended to many millions from the lowest brightness that the visual sense can detect with ease.

Besides the many obvious applications in the measurement of brightness, this instrument by itself is useful in the study of brightness contrasts in the field of lighting because they have much influence upon comfort in seeing and some influence upon visibility. Quality of lighting, which includes chiefly the distribution of brightness in the visual field, should be studied by lighting specialists along with brightness. Our development of this device has been largely inspired by this need.

Footcandle measurements are common and necessary, but they have overshadowed measurements of brightness and brightness contrast entirely too much in practice and sometimes in theory.

[1] Matthew Luckiesh and A. H. Taylor, "A Brightness Meter," J. O. S. A. 27, 132 (1937).

NEW SERVICE, SUPPLY UNITS TO OPERATE IN THE THEATRE FIELD

By *JAMES J. FINN*

THE outright sale by Electrical Research Products, Inc., of all its 4,600 domestic theatre service contracts to a group of ex-Erpi employees, backed by Wall Street money, and the efforts by another group to form a new national theatre supply combine are current happenings of more than passing interest to all projectionists. (Exhibitors, too, might with profit to themselves, manifest some interest in these occurrences, but this angle is beyond the ken of I. P.) The servicing deal is an accomplished fact; while the sponsors of the theatre supply deal aver that the decks will be cleared for final action within sixty days.

Heading the group of ex-Erpi employees in the new servicing organization (likely to be known as Interstate Theatre Service Co.) is L. W. (Mike) Conrow, formerly operating manager for Erpi and slated to be general manager of the new company. Associated with Conrow will be George Carrington, who becomes operating manager; Bert Sanford, Jr., as director of sales; Stanley W. Hand, who will oversee field operations, and L. J. Hacking—all ex-Erpi employees.

The Wall Street flavor in the deal is supplied by Roswell C. Tripp and Howard P. Engels, who are reported to have severed their connection with the investment house of Munds, Winslow & Potter in order to devote all their time to the new venture. Rumors that A. T. & T. would retain an interest in the new company, or had "arranged" financing for the deal, met with official emphatic denial.

A. T. & T. Quits Theatre Field

Sale of its theatre servicing contracts marks the passing of A. T. & T.'s direct interest, through Erpi, in the sound picture reproducing field. This situation was forecast in these columns more than two years ago, gaining credence through the recent licensing by Erpi of International Projector Corp. and Motiograph, Inc., to manufacture and sell Western Electric sound equipment under A.T.&T. patents. Erpi will continue active in the domestic recording field, as well as in the foreign recording and reproducing field. However, it is all through in the American theatre field.

Interstate, the new servicing company, will continue to occupy the present Erpi headquarters in the Fisk Building at 250 West 57th St., New York City. Most of the existing Erpi offices in the field will be maintained, new offices being opened and old ones closed as conditions warrant. All Erpi servicing and operating employees will be retained, it was announced, but there will undoubtedly be some changes in personnel. The Erpi inventory of replacement parts will be taken over by Interstate.

The sale price of the 4,600 theatre service contracts was not announced by either Erpi or Interstate. The writer can say with authority, however, that when Erpi attempted to dispose of its service contracts some two months ago it was asking around $300,000, which price was nixed by the interested party. It is extremely doubtful that Interstate paid even one-third this sum for the contracts. Figuring importantly in Interstate's pre-deal estimates was the knowledge that the severance of servicing activities from the A. T. & T. family group would eliminate charges for administration, engineering work by Bell Laboratories and other big-company concomitants which constituted a large percentage of Erpi's operating expense.

Thus crumbles into dust the huge industrial structure reared by A. T. & T. in the entertainment field. The history of Mother Bell's excursion into show business is a separate and highly dramatic tale in itself, but it may be noted in passing that the disintegration of Erpi was a foregone conclusion to those who realized very early in the game that no utility like A. T. & T. could long operate a sideline of the proportions assumed by Erpi shortly after sound pictures were introduced. Various reasons are advanced for the divestment of Erpi, but the writer views it as the inevitable result of that intangible yet inexorable force known as public opinion. In fact, he dates Erpi's decline from the time it first announced its program for inclusive theatre servicing "from the roof to the cellar," a plan which would have sucked Mother Bell in just so much deeper, probably with disastrous results not only to its entertainment field subsidiary but also to its much greater stake in the "nickel-in-the-slot" business.

Ill-Fated 'Inclusive' Service

The only possible explanation of the ill-fated inclusive service plan is the bad advice tendered by Erpi insiders. This plan was a "natural" for those Erpi workers who, noting the declining income from Erpi sales and service contracts (the latter the result of inroads by RCA and by independent, including Union, agencies), decided to fur-line their jobs through the simple process of expanding Erpi's business. The roar of protest which greeted announcement of this plan, in the writer's opinion, was particularly damaging to Erpi prestige and

MANY PERSONNEL CHANGES IN THE SOUND FIELD

NUMEROUS changes of personnel in key positions have occurred as a result of the new set-up in the sound picture equipment field stemming from the granting of licenses by Erpi to both Motiograph, Inc., and International Projector Corp., and also by RCA to the latter.

E. M. Hartley, formerly manager of RCA Photophone sales has joined the managerial staff of General Theatres Equipment Corp., for which he will supervise all sales activities on sound equipment. J. Frank, Jr., also formerly with RCA but who has been with International Projector Corp. for the past year, has been transferred to National Theatre Supply Co. in connection with promotion of sound and visual projection equipment.

George Friedl, Jr., for many years associated with Erpi, has been named director of the sound engineering division of International Projector Corp. Friedl will concentrate on the design of an all-new sound equipment.

E. P. Kennedy, former Erpi technician, has been appointed director of sound engineering for Motiograph, Inc. This company will shortly begin construction of a new $125,000 plant which will also house a research laboratory.

Harry L. Sommerer will take over all sales and servicing activities pertaining to RCA Photophone reproducing and recording equipment and will also direct the activities of the Hollywood plant. His headquarters will be in Camden. Mr. Sommerer has been director of RCA activities in Japan for the past seven years.

contributed far more than anything else (including the Federal investigation of A. T. & T.) to the decision by Mother Bell to move out of the entertainment field—and fast.

New Supply Store Combine

All of which makes for entertaining reading; but what does it mean to those interested in theatre service and supply? Preceding the answer to this query must be consideration of the projected plan to form a new national distributing organization.

As it happens, this project also has an Erpi flavor, but by accident rather than design. The guiding spirit in this enterprise is Charles C. Bunn, formerly general sales manager for Erpi and now "on his own." At least, Bunn is doing the missionary work. The plan, as submitted to various independent supply dealers, is simplicity itself—to those of us not in the supply business:

Mr. Bunn sets before a supply dealer an option for the purchase of his business which provides, among other things, the following: profits during the past five years will be lumped together; cash amounting to the best single year's profits within this period will be paid immediately; the remaining four-fifths will be paid off by certificates commonly known as stock; Mr. Supply Dealer will then be tendered a seven-year contract to manage the branch at a salary to be "mutually agreed upon." Open accounts not more than 60 days old will be figured in on the profit column; older accounts will be figured in "as, if and when" collected. Present inventories will be figured in on some "equitable basis." The deal will not be effective until a minimum of 15 dealers have signed the purchase agreement.

There may be one or more errors in the foregoing summary, but this is not surprising in view of the extreme secrecy surrounding the project. Ben Shearer, of Seattle, and Joe Hornstein, of New York, prominent independent dealers, are credited with being the prime movers in the situation, with Bunn as the advance man. Messrs. Shearer and Hornstein, however, advised I. P. that they are "emphatically not promoting the new company" but are merely sitting on the sidelines and watching developments. Samuel Spring, of New York, prominent in the picture field, is the attorney of record.

Rumor has it that 17 dealers have already signed the purchase option, which is sufficient to validate the deal. Several prominent manufacturers have advised I. P., however, that not more than 3 dealers have signed. Reports linking Motiograph, Inc., with the project were immediately denied by this company; ditto for Brenkert Light Projection Co. All of which points to Bunn as the prime mover in the deal—that is, if all denials of participation by manufacturers and dealers are accepted at face value, Suspicion that the financing for this deal originated in the same place as did the money for the Interstate service company was dispelled by means of a little gumshoe work by I. P.

Not Harmful to N. T. S. Co.

Should success crown the efforts of Mr. Bunn, it would bring into being a rival organization to National Theatre Supply Co., subsidiary of G. T. E. Nor would this situation be displeasing to National, because it would mean that the present independent methods of accounting would be discarded in favor of a modern system which would consider depreciation, sales expense, a definite credit policy, and general overhead — which trifles have annoyed a great majority of independent dealers hardly at all. Independent dealers have long been notorious for inept accounting methods: a dealer with a fixed overhead of, say, 20% would think well of an 8% margin on a deal. I. P. fails to see where a new national distributing company would step on National's toes; in fact, it should prove definitely helpful.

Sources of equipment supply might prove a tough nut for a new national distributor to crack, particularly if certain prominent manufacturers elect not to "play ball" with even such a large purchaser. Would this mean, then, that the new supply company would either purchase certain existing companies or launch their own manufacturing units? We shall see.

All of which brings us back by a circuitous route to consideration of how these various moves will affect the theatre field in general and projectionists in particular. The picture looks like this: International Projector Corp. and Motiograph, Inc., will sell sound equipments—the former through National Theatre Supply and the latter through the present independent dealers. If the new dealer combine goes through, Motiograph will have to revise its distribution set-up to some extent.

Neither International nor Motiograph will offer their own service. They have the right to sell Interstate contracts (receiving 10% thereon); or Mr. Exhibitor can take either no service or contract with some other service group. This leaves both Motiograph and International out of the Union servicing situation. The dealer organization now being formed by Bunn will also have the right to sell Interstate service. Interstate itself will, naturally, sell all the service contracts it can, irrespective of type of equipment. RCA is even now selling service on all equipments.

Thus the picture. The writer sees in the formation of the new dealer set-up just about the best opportunity for price-fixing extant. Of course, if all independ-

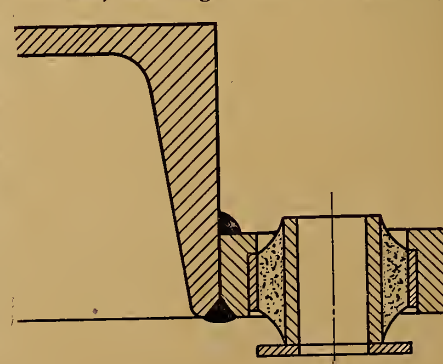
Sidelights on M. G. Set Operation

By *WILLIAM H. HAINES*
COMMERCIAL ENGINEER, ELECTRIC SPECIALTY CO.

The writer was much interested in reading the article by L. P. Work about motor generator sets in your October issue (p. 18), and would like to add one or two comments concerning modern refinements of design.

In an ordinary direct-current generator, the most pronounced causes of ripple voltages or constantly recurring variations in the d.c. voltage are the armature slots and teeth. As they pass the pole pieces they cause fluctuations in the flux of the machine which, of course, produce voltage fluctuations. These fluctuations can be greatly reduced by assembling the armature slots and teeth at an angle instead of parallel to the shaft. All good d.c. generators for motion picture projector lamps are furnished with the armatures assembled in this manner, which is usually called "skewing" the slots.

Mr. Work mentions rubber mounting and indicates that to obtain proper cushioning effect the machine should not be bolted down. A process has been developed for bonding resilient rubber to metal attaching members which takes advantage of the greater ability of rubber to absorb vibration in shear than when stressed in any other way. Mountings of this type are available which may be installed in the feet of motor generator sets, enabling them to be securely



bolted to the floor and yet providing the complete cushioning effect of the rubber. The accompanying sketch shows the details of such a mounting.

ent dealers were combined today, there would arise tomorrow a new crop, which would be steadily augmented as time passed. But the existence of only two national distributing groups certainly would be conducive to price-fixing—even if neither group entertains any such thought at the moment. In any event, prices to theatres will certainly be raised. That's all that need be done about the dealer combine at present.

Service is a different proposition. Interstate apparently will not have such easy sailing. Unionization of all servicemen is ever threatening, and even today the Union effectively bars Interstate activity in cities such as St. Louis, Cleveland, San Francisco, Cincinnati and other strictly Union-controlled service centers. This Union servicing undoubtedly will spread to other cities. In addition, almost every large theatre group has its own servicing organization; witness 72 Loew theatres in the N. Y. area, Warner Theatres throughout the country, M & P. Theatres in New England, and the Bob O'Donnell group in Texas—to mention only a few. These groups constitute a healthy slice of the service field, more so because most of them are small-cost groups clustered in one area.

Erpi's passing from the theatre field

contributes nothing to I. P.'s pet notion that each Union should handle all servicing within its jurisdiction, but merely means a switch from Mr. Tweedledee to Mr. Tweedledum. I. P.'s exhortations to Unions on the necessity for taking over service work have been repeated herein *ad nauseum* and need no further exposition. Those Unions who took advantage of the opportunity offered are today reaping the manifold benefits to be derived therefrom. Bereft of the Erpi label and its connotations of Bell Laboratories and Western Electric engineering brains, the Interstate company will hardly exert the pull on exhibitors that was the very cornerstone of Erpi salesmanship. This means, then, that in any competitive bidding on service right now neither a Union nor any other independent group would be at any great disadvantage on the score of prestige, etc. This being so, one can only wonder what's keeping the Unions on the leash and marvel at their seeming indifference to one of the best organizing opportunities of the last decade.

What Mr. Smith of Interstate can deliver Mr. Jones of a Union can deliver. Or can't the latter?

A. T. & T. SHOWS COAXIAL TELEVISION SYSTEM

The A. T. & T. system of television transmission via coaxial cable were demonstrated again recently at the Bell Telephone Laboratories. The pictures were 240-line images, as contrasted with the 441-line image utilized by the RCA system, this limitation resulting from the nature of the experimental terminal and repeater equipment on the cable. Bell engineers asserted that they could easily step up to 350-line images. The images, approximately 7 x 8 inches in size, were satisfactory on the score of both definition and steadiness.

Extremely important is the distance traversed by the coaxial cable system, totaling 180 miles from New York to Philadelphia and return. Bell officials made no predictions anent possible future developments of the system.

TROUBLESOME ELECTRICAL, MECHANICAL DEFECTS

Divers electrical troubles cause their share of stops. If all contacts, switches, fuses, *etc.*, can be kept cool, there will be little trouble. Much of this apparatus runs fairly warm as a rule, and when it is behind the enclosed switchboard it is difficult to tell if the temperature has taken a sudden rise in the last hour or so. When connections are warm consistently, a slight rise in temperature may be dangerous. Possibly the current at the arc is somewhat above normal, or the resistance at some connection may have increased slightly, or even an unusually long reel combined with either of the above, might bring the trouble; then the connection burns off or the fuse goes out.

Then there are the mechanical failures and also those due to the film. Bad sprocket holes, bad splices, wobbly reels that finally either break the film or tear the sprocket holes, are no help in this respect. Poorly adjusted pad rollers and hooked sprocket teeth often aggravate these troubles.

Most mechanical troubles are probably due to take-up belts and certain drives found in some of the sound equipments. Occasionally we still hear of the mechanism that freezes up. On one type of sound head there is nothing to do but stop in the event of take-up trouble. Ordinarily it is possible to

turn the take-up by hand, or even take the film up on the rewind as it comes off the machine. This is not the best practice but it is better than stopping the show.

CHRISTMAS SEAL CAMPAIGN

(*Continued from page 19*)

culosis; who must know that it is still the disease causing most deaths among our young people between 15 and 45; who must take himself or herself to the doctor at the first signs of trouble; and who must practice hygienic living every hour of every day.

"We have not stressed hygienic living sufficiently—or rather, we have not yet made it sufficiently popular," said a prominent Columbia professor recently as she recalled for her class the careless etiquette of cafeteria patrons who handle food and return it, with hands of questionable cleanliness. How easy for the tubercle bacillus to reap a harvest under these conditions!

Fortunate indeed is it that we have organized groups in this country to fight tuberculosis in every corner of the land—fight it to a great extent with education of the masses, and with tuberculin testing and X-raying of suspected cases. These groups are the local tuberculosis associations who, working with the state association and the National Tuberculosis Association, are in large measure responsible for the tremendous decline in the death rate since the turn of the century.

Into the forefront of the fight, each year at Christmas time they send out gay little Christmas Seals for our Christmas gifts and mail, stamps to "stamp out tuberculosis." Filled with the true Christmas spirit of good-will, these seals

make possible new life and hope for many. Men and women are urged to buy them with even greater enthusiasm in 1937 than they did in 1907 when the first seal appeared in this country. For today they have proof of the power of these colorful bits of paper to overcome an ancient disease.

This year, a jovial town crier greets the Christmas season *via* the seal with the double-barred cross—a town crier all muffled in wool, against a wintry scene. As he lights his way with his lantern down the village street, and swings his merry bell, would that his cry might be, "No more mattress years ahead. Tuberculosis at last wiped out of our land!"

Buy Christmas Seals!

STEREOSCOPIC MOVIES: PAST, PRESENT AND FUTURE

(*Continued from page* 16)

entations (that is, longer than ten or fifteen minutes) can be watched by a normal audience without some eye strain. (2) Many authorities, of whom Troland is one, say that such anaglyphs produce special separations suggesting the flats in stage scenery. They do not produce rotundity or solidity; that is, the niceties of stereoscopic sensation seem to be absent. (3) Such a use of color to produce stereoscopy precludes the use of varied color in the pictures themselves to enhance the suggestion of reality.

Early Polarization Work

With the method depending upon polarization, work was done by Anderton as far back as 1893. Using piles of plate glass, he showed that three-dimensional pictures obtained by this method were a laboratory possibility; but his necessary use of glass plates made them economically and practically an impossibility. With the advent of Polaroid,[1] the thin polarizing sheeting that can economically be produced in large areas,

[1]Tuttle, H. B., and McFarlane, J. W.: "Introduction to the Photographic Possibilities of Polarized Light," *J. Soc. Mot. Pict. Eng.*, XXV (July, 1935), No. 1, p. 69.

there has been a new interest in the field.

The present is an auspicious time to consider the motion picture field and the subject of stereoscopic motion pictures. Color movies are today better than ever before and show promise of still greater improvement. Polaroid is now available, and this permits for the first time color movies in three dimensions. There is considerable laboratory evidence to indicate that the ordinary run of color-film, when stereoscopic, is considerably more effective than the best single-eye color pictures. For this there are several good reasons:

Polaroid A Great Advance

(1) In nature the respective highlights are in slightly different positions for the two eyes. This is part of our natural impression of the world. (2) An effect is produced upon any object by the kind of light illuminating the object. To give an example, suppose we have a statute of pink or black marble in a room in which the color is predominantly green. In such a case, one will have not white reflections, but green reflections. Now this experience is common, and our eyes are able to remove, as it were, the green reflections from the pink marble and see the marble as it really is; whereas one is unable to do so with a single picture of such a pink marble statue on which there is a green reflection. This is a good experimental reason why, no matter how good color reproduction may become, there will always be dissatisfaction in the representation of colored objects by non-stereoscopic "flat" movies. All objects have to be illuminated, and from all surfaces there is more or less reflection of such illumination. Gold and luminous objects generally have been the despair of color photographers. This again is partly due to the fact that these are essentially two-eye phenomena, the lighting and color effects in one eye differing from those in the other in actual viewing.

Considerable advance has been made in devices for taking and showing stereoscopic pictures on a single film, and present experiments are very promising.

There are, very naturally, some problems to be cleared up. Photographers need to learn (1) limitations, or what they should not expect to do with stereoscopy and (2) still more important, what its use means in opening up new possibilities—in other words, the technic of using this new tool. There is some evidence to show that a new sense of space must be acquired and a much more painstaking and thorough use of the fact that space is now an ally, not something to be avoided or faked. The color possibilities deserve very careful study, and undoubtedly a new lighting technic will be needed to supplement what is already known and being used.

In particular, this is a very powerful tool for greater reality in close-ups. What were flat surfaces now become solid, plastic objects. Stereoscopy provides the ideal medium for rendition of shades, the finest wrinkle, the texture of the skin—all the niceties that, summed up, create the impression that one would actually have if he were really experiencing a close-quarters reaction to the actress or actor. In all probability, many long and middle-distance shots that were previously required to give the sense of space will now become unnecessary. Conversely, many long shots that had to be avoided because of the difficulty of showing the actual space involved will now be a possibility to the picture technician. All in all, it presents a very interesting and exciting medium for imaginative workers to utilize.

Few Projection Changes

These are the problems and interests of picture taking. Theatres will need to know any changes in the method of projection that may be necessary. Fortunately, these appear to be slight; and, in general, where single-picture projection was really satisfactory, stereoscopic projection will with small modification be similarly satisfactory. As in the case of single-picture projection, there is a best viewing position. The area around this position in which viewing is still excellent is at least as large for stereoscopic as for ordinary pictures. The final problem lies in the distribution of

glasses and their possible use again.

Lumiere in France has apparently successfully solved this problem through the sale of expensive glasses to those who wish to use them and own them permanently, and the loan of cheaper glasses that are taken back after each performance and sterilized. At the New York Museum of Science and Industry where four presentations of stereoscopic movies are held daily, it has been found thoroughly practicable to take back the glasses and use them over and over again, with a disinfecting treatment after each such use. (After all, the utensils we use daily in restaurants and other public places constitute a similar problem in antisepsis).

When 35 mm. color motion pictures are taken with the proper technic and projected full-size upon a large screen, the result to the observer will be living movies. The audience will be sitting at a window and seeing the actual scenes and the living actors as if present in the scene. The screen disappears; one is no longer conscious of looking at a flat surface. Objects stretch back from the frame of the screen to infinity and can even be made, if desired, through a known technic in taking the picture, to come right out of the screen toward the audience.

Through light we receive probably 85 per cent of our external impressions of the world, and there are three fundamental principles in its use. The first, two-color and intensity, have long been with us. The third, polarization, is being made practical for the first time through Polaroid, the invention of E. H. Land of Boston.

Ordinary light can be said to vibrate in all directions at right-angles to the direction in which it is travelling. Polaroid is made up of a multitude of submicroscopic crystals, each having polarizing properties, all lined up perfectly and immovably embedded in a transparent sheet. The effect of these crystals is to absorb vibrations along one of their axes. Such alterations of light are not obvious to the viewer unless we have a second piece of Polaroid with which to observe it. However, if a second sheet of Polaroid is placed in front of the lighted area, all goes dark when the axes are crossed or light when the axes are parallel.

(Incidentally, when a cellophane design is placed between the two pieces of Polaroid, this colorless, transparent material lights up with colors that can be reproduced at will and that are permanent; and as the front Polaroid screen is rotated, the colors gradually change to their complementary opposites. For the first time it is possible to have large designs or plain colored areas that are changeable at will, permanent and reproducible.)

Now, if the front Polaroid screen be removed and the observer put on his Polaroid glasses, his left eye sees the screen clearly; the right eye view is dark. If he tilts his head far over to the side, or removes the glasses and holds them vertically, he will see that now the right eye is transparent and the left eye dark. When taking the picture no such material was used. This same device used in front of the projector, or one similar to it, is mounted upon the camera to take two pictures eye-distance apart and place them upon the film side by side. These two pictures are projected again through this device, and upon leaving the device the two eyes are again separated.

At this point each eye has a piece of Polaroid placed in front of it. The right one transmits horizontal vibrations and the left one vertical, exactly as the glasses are arranged. The right eye sees the right-eye picture but not the other. Conversely, the left eye sees the left-eye picture and not that intended for the right eye. The essential condition that each eye sees its own picture and only its own picture is achieved. There is nothing to be adjusted mechanically or otherwise. One forgets the glasses and looks at the living scene unfolding itself before him; and best of all, the eyes behave as they would if they were present at the scene. They converge when the objects are near, and change their convergence for varying distances as they normally would do in life.

GOOD PROJECTION SPELLS GOOD BOX OFFICE

IT TAKES *both* good pictures and good projection to keep patrons flocking back for more! In these days of increasingly high standards, people won't tolerate unsteady pictures and eye strain.

Pleased patrons are your greatest asset. So why jeopardize your patronage by gambling with IMITATION Simplex Parts and inferior projection—particularly when Genuine Simplex Parts cost so little.

Only Genuine Simplex Parts assure perfect projection. *Only* the maker of these parts—the manufacturer of your Simplex Projectors—has the fine precision equipment, the testing facilities and the experience which guarantee the extreme accuracy and wear resistance which perfect projection requires.

When you have your projectors repaired, remember that good projection spells good box office. *Insist* on Genuine Simplex Parts. They are now sold by National Theatre Supply Company at 36% off list.

INTERNATIONAL PROJECTOR CORP., 88-96 Gold Street, New York, N. Y.

DISTRIBUTED BY NATIONAL THEATRE SUPPLY COMPANY

Ip

International PROJECTIONIST

DECEMBER 1937 Vol. 12, No. 12

25c Copy

$2 a year

It's Uncanny

How the public spots good pictures without knowing technically why they are good.

Neither do they know anything of the technical phases of sound and projection but they have a definite appreciation of perfect presentation, one of the features of which is the brilliance of the picture when projected with a high intensity arc.

SIMPLIFIED
High Intensity
PROJECTION

is now within the reach of even the smaller theatres.

Strong
LAMPS

UNCONDITIONALLY GUARANTEED

—the Reliable Guide to Better Projection.

An Invitation!

Write for interesting catalog and name of your nearest Independent Theatre Equipment Dealer. He will, without obligation, arrange to demonstrate the Strong High Intensity Lamp in your theatre.

The STRONG ELECTRIC *Corp.*

2501 LAGRANGE ST. TOLEDO, OHIO, U. S. A.

EXPORT OFFICES:

ROOM 2002, 220 W. 42nd ST., NEW YORK, N. Y.

JAN -5 1938

©CIB 362776

International PROJECTIONIST

With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

Volume 12 DECEMBER 1937 *Number 12*

Published Monthly by

JAMES J. FINN PUBLISHING CORPORATION

580 FIFTH AVENUE, NEW YORK, N. Y.

Circulation Manager, Ruth Entracht

Subscription Representatives

Australia: McGills, 183 Elizabeth St., Melbourne
New Zealand: Te Aro Book Depot, Ltd., 64 Courtenay Place Wellington
England and Dominions: Wm. Dawson & Sons, Ltd., Pilgrim St., London, E. C. 4.

Yearly Subscription: United States and possessions, $2 (two years, $3); Canada and foreign countries, $2.50. Single copies, 25 cents. Changes of address should be submitted two weeks in advance of publication date to insure receipt of current issue. Entered as second-class matter February 8, 1932, at the Post Office at New York, N. Y. under the act of March 3, 1879.

International Projectionist is not responsible for personal opinions appearing in signed articles in its columns.

420

MONTHLY CHAT

WITH the next issue I. P. will blossom out with a new cover and other changes of format which are intended to make the old journal more attractive, more convenient and, therefore, more useful to you, Mr. Reader. At least this is the goal we have set for ourselves, and we think we will reach it. If, however, I. P.'s new dress doesn't particularly appeal to you, or if you have any suggestions for improvement, just step up to the line and yell.

MENTION of which reminds us (reminiscence being permissable at year-end) that I. P. is getting along in point of time, if in no other respect. Yep, now turning into its seventh year, which fact, while hardly suggestive of flowing whiskers, marks the longest span ever covered by a journal devoted exclusively to professional projection that has won international recognition. Please omit flowers.

It might be interesting to compile a not-to-long digest of the happenings, technically and otherwise, of the past six-and-something years, as gleaned from the files of I. P. We'll see about this for the next issue.

THE incredible has happened! I. P. is finally giving something away. We refer to the offer of worthwhile prizes for the best answers to the questions appended to Aaron Nadell's article in this issue. We figured that we would give those technical Goliaths something to shoot at. (Or be shot at when we announce the winners.)

THE toughest projection problem at the moment (and for years past and a few more to come, too) is the establishment of a screen brightness standard that will be applicable to all types of theatres irrespective of physical proportions, type of equipment or operating conditions. Merely specifying that such-and-such type of theatre should maintain a certain screen brightness means nothing. Some of the best technical brains in the industry have been baffled by this problem. Just as an idea of the work involved, the Projection Practice Committee of the S.M.P.E. figures that its end of this job will require at least two years.

REAMS of "promotion material" reciting the glories of television and its "many splendid opportunities" for the "far-seeing technician" pour into editorial offices in a never-ending stream. I. P. has repeatedly cautioned its readers against fake stock-selling plans and against enrolling in 25-easy-lesson courses. Buy no stock, no books and enroll in no "courses" until you are competently advised. I. P. will be glad to help you.

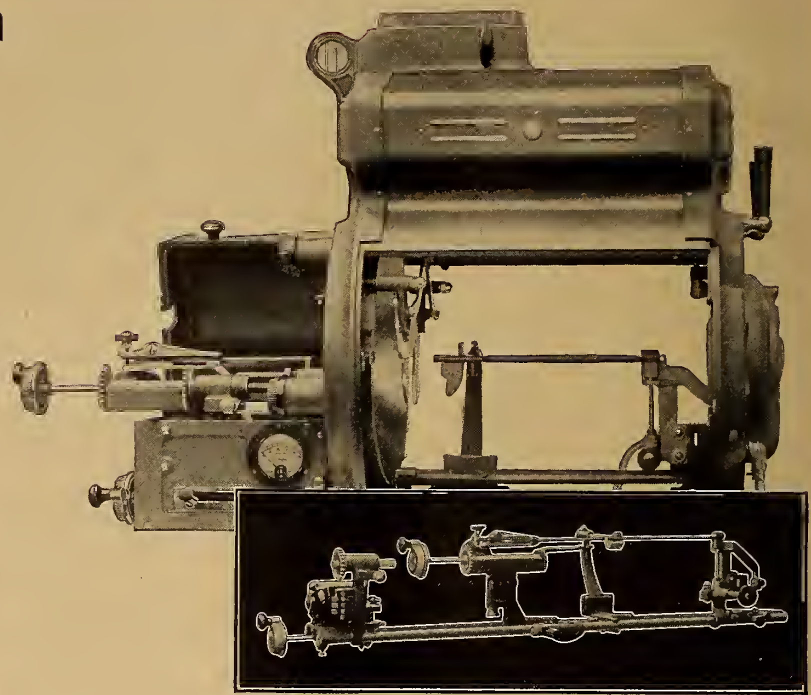
I. P.'s greeting to its friends throughout the world: During 1938 the best of everything that life has to offer.

YOU BET YOU WANT:

FULL CARBON TRIM

UNDER ALL CONDITIONS!

You'll get it with Brenkert ENARC Lamps



SIMPLIFIED
High Intensity
PROJECTION

There's no need to shorten the carbon trim to get correct projection when you use Brenkert ENARC Lamps. They give you full carbon trim on all standard make projectors, and maintain all correct optical distances—from mirror to film—for correct screen illumination. Clamp that carbon right on the tip end—use its full length with one setting. You increase efficiency of operation—gain convenience—reduce the number of carbon changes.

Arc adjustments are made with micrometer precision, on positively accurate screw-feed.

Brenkert specialized engineering has made ENARC the ideal lamp for the projectionist. Ideal for the management too, for it means gratifying economy. Brenkert ENARC is the only completely Unit-Assembled Projection Lamp. That means minimum service time.

Stop in at the convenient and capable Brenkert dealer and find out more about it!

THE ECONOMICAL LAMP FOR HIGH INTENSITY PERFORMANCE

BRENKERT LIGHT PROJECTION CO.

ENGINEERS AND MANUFACTURERS

DETROIT, MICHIGAN, U. S. A.

INTERNATIONAL PROJECTIONIST

VOLUME XII NUMBER 12

DECEMBER 1937

NEW SERVICING TOOLS NEEDED FOR VISUAL PROJECTION EQUIPMENT

By *A. C. SCHROEDER*

MEMBER, PROJECTIONIST UNION 150, LOS ANGELES, CALIFORNIA

THINKING about past developments in projection brings to mind future possibilities. The average projectionist immediately sees television in large letters; but this is neither the story of television nor of the machines or lamps of 1948. We shall discuss here equipment for servicing the *visual* projection units. We all know the sound serviceman is equipped to do his work, and that he has more apparatus available when special work or testing is necessary. What visual test equipment has the projectionist? Frequently he does not have a set of tools.

How can the projectionist know if he is getting eight foot-candles on the screen? Or even if it *should* be eight foot candles? The eye can discern very small variations in illumination, after it has become accustomed to a certain level, but with ordinary lighting a small variation of light cannot be seen; a substantial increase is required before any change is noticed. Admitting that the eye itself cannot reliably judge screen illumination what else is available at present?

In one Los Angeles theatre the light looks absolutely even over the entire screen, at least to my eyes. Occasionally studio representatives measure the light, and usually find a difference of one foot-candle between the center of the screen and the sides. This is exceptionally good, so far as evenness of illumination is concerned. What is this variation in other houses? The projectionist is unable to find out.

Judging Screen Illumination

We wonder, therefore, if projectionists in the better houses will not have some day a photometer or some other contrivance with which to measure screen light. The author has used a Weston photographic exposure meter for this, but enough work has not been done with it to prove its applicability. It lacks sensitivity and range, that is, it should measure both lesser and greater degrees of light. At the lower light values a condensing lens of fairly large diameter could be used to collect the light rays and focus them on the exposure meter. The device could be compared with a standard photometer, and a chart could be made showing the value in foot-candles for readings obtained with the Weston instrument. The latter is not the only available meter, as there are others of a similar type.

While discussing photometers, we wonder what calibrating standard, if any, applies. It seems that each one brought to our theatre is a different type, or is calibrated differently. No two readings taken at different times are ever alike. Oh, no, our light does not vary that much. Questions put to the engineer evoke the information that it was calibrated by such-and-such a method and thus will give different readings than were obtained previously, or that he is using a different type instrument this time.

All this does not help *us*, except that it indicates the evenness of illumination; whether the light from all machines is the same, and whether the screen is getting dirty. The latter is determined by comparing the amount of light arriving at the screen with the amount reflected. Regardless of the instrument used, or its calibration, or whether the light from

our lamps has changed, if the reflected light is substantially less than the value obtained at some former date, there is a larger loss of light at the screen, showing that it should be cleaned.

If we had our own measuring instrument we could tell if the screen light was falling off, which it must be continually, judging by the pitted lamp mirrors. We could tell when the screen light was maximum, and we also could obtain the maximum light per dollar, considering current and carbon consumption. It may be uneconomical to try for the maximum light. It is doubtful if a change from nine to ten foot-candles would be noticed. Coming in from outdoors one would certainly not know that the light was brighter than it was one week previous. It may be advisable, therefore, to keep the light level at nine foot-candles, as the extra light would not justify the increased cost.

Determining Proper Tension

How much tension is applied to the film at the gate? Today we have no method of ascertaining this, nor do we know the proper tension for good projection. Will we have an instrument to measure this at some future time, and a standard to go by? It seems quite possible to make such a device: it will soon be learned what tension produces the best performance, and with the least damage to the film. We would learn how much harder a "green" film pulls than one that has been run for several weeks; or if the thin stock on which the news reel is printed goes through differently than the other stuff; or what effect Technicolor prints have, if any.

With proper tension, if the picture is not steady, the movement might need overhauling, or the tracks or the shoes might be worn, or possibly the sprocket teeth are beginning to wear, although not enough to be noticeable. Some day we may even have a device to indicate when the teeth are worn to the point where they damage film.

As an example of what has been done along somewhat similar lines, some years ago RCA used a small spring scale to adjust the tension at the sound gate. It had been determined that the gate rasp was least with a certain tension. It was only necessary to establish this value to be sure of the best possible adjustment. Erpi also found that sound gate tension was important, but instead of adjusting the tension to a specified value, they adjusted it to a point of minimum flutter, and limits were set so that the service men would know if the equipment was up to standard.

Obviously, the decision as to flutter was not predicted on aural tests, but the actual per cent of flutter was shown by meters on a device called the "flutter box." These two instances serve to show that the servicing of sound equipment has been reduced to an exact science, while the projectionist working with visual projection machinery, which has been developing for years, still is groping in the dark.

Let us not forget about the tension on the upper magazine and the take-up spindles. These adjustments are pretty much guesswork now. It would be better and quicker if we know what tension was required and had an instrument so that we could set it exactly.

Intermittent Movement Problems

What about the intermittent movement? Some of them are faulty when new or after they have been overhauled. Sometimes they are so tight that there is danger of them freezing up. Is it possible to devise an instrument that will measure this accurately, so that we will not have to trust to the "feel" of it by twisting it in the hand? How can we tell that the hop in the picture is not due to a defective star wheel, one that moves the film in different amounts for the various positions?

Years ago a Los Angeles projectionist made a device to indicate just this. It was a fairly large disc with a hub that slipped over the end of the intermittent shaft and was fastened by a set screw. Near the edge were four equidistant lines, and a pointer was fastened to the projector so that it exactly registered with one of the lines when the movement was in the locked position. The movement was then turned to the other three positions, and if each of the lines on the disc lined up with the pointer, one after the other, it was certain that the movement was O.K. in this respect. If one or more of the lines did not exactly coincide with the pointer as the movement locked in the corresponding position, the movement was defective, and no amount of work or worrying would do any good.

What if the intermittent shaft is sprung, or the intermittent sprocket is eccentric? A machinist's dial indicator will quickly determine this. The indicator is clamped to the projector so that the contact button is resting on the shaft. If the shaft is sprung, the indicator will show it in thousandths of an inch as the machine is slowly turned by hand. In case the shaft is perfect, the test is then made on the periphery of the sprocket in the same manner, which shows that the sprocket is concentric, or otherwise.

We had a Movietone constant-speed sprocket with this defect, which had been in use for some time. The sound on one machine was not quite as good as that on the other, yet nothing wrong could be found. The sprocket was not out enough to be seen by the eye. When the indicator was applied, the trouble quickly showed up.

How do you line the lateral guide rollers at the top of the film trap? One of the local shops has a jig with which to do this. It is slipped into the film trap door holder, then the rollers are adjusted to it, and the intermittent sprocket is checked for position at the same time. This is very fine, but it doesn't do us a bit of good in the projection room, which ought to have some such rig.

Cleaning Magazine Rollers

A device which would effectively clean the magazine rollers would be welcome. Possibly the projector manufacturer should do something about this. The solution really is a change in the parts concerned, which might be made so that they could be removed at once, cleaned thoroughly, and replaced quickly. It is quite a bother to clean them now, thus the job is done infrequently.

Why should it be necessary to remove a magazine to do this simple routine job? Running a rag between the rollers *may* accomplish the purpose, and again it may not. It is uncertain at best. A valve *could* be made so that it could be opened and cleaned even while the projector is in operation. The underwriters might object to this, in which case it could be made as a dual valve, one part remaining in operation while the other part was open or removed for cleaning. With both parts closed it would give double the protection we now have. More projection is needed here, because these rollers do not always prevent a fire from getting into the magazine. This dual valve would not increase the hazard of scratching, because they would be cleaned at least once, and could be cleaned several times, during the day if it seemed advisable.

The pad rollers should be adjusted a distance of two film thicknesses from the sprocket. We place the doubled film on the sprocket and then adjust the rollers. This is a clumsy and awkward procedure. Feeler gauges can be used in the place of the film, but first the film must be measured with a micrometer, or its thickness ascertained in some other way. Even the feelers are not

(*Continued on page* 33)

● *In the Next Issue*

—will appear complete data, including many illustrations, anent procedure for projecting "Hi-Range" prints in the theatre, standard nomenclature for Release Print sound tracks, and standard fader setting instructions. ●

Television Problems—
A Description for Laymen

By *ARTHUR VAN DYCK*
MANAGER, RCA LICENSE DEPARTMENT

This is the first of a series of articles covering recent technical developments in television and charting the future of the art. Written by acknowledged authorities on the subject, these articles will prove invaluable to those who are interested in the progress of this baby art—as are most projectionists. These articles were compiled and are copyrighted by RCA Institutes, Inc., and appear herein through the courtesy of that organization.

RADIO has attained its present position of important widespread use so rapidly that it has not been possible for people generally to gain a clear understanding of it, to the degree they do understand many other technical devices, such as the automobile for example. When radio's new service of television arrives, there will be even more intimate contact and impact between radio and the home. Many people realize this and an interest in "how television works" is frequently expressed to radio engineers. This article is an attempted answer to those questions.

The first point of interest is that everyone has heard of television, that public interest in it is widespread—although it has not yet reached even the first beginnings of commercial or public service. That is unusual in scientific developments, and an understanding of why it is so will explain much about television. Most developments come to public attention with the starting of public service in some form, and the laboratory stage passes by unknown and unsung. The sound motion picture, even sound broadcasting, are recent examples of new arts bursting upon the public stage full grown and ready to act.

But television has been different. For ten years it has been written about in public print, everyone has heard of it and conjectured about it, all without a commercial practice or a public service. Why has this been? American business has not suddenly changed its outstanding characteristic of rapid utilization of new developments and become laggard in making new services available. On the contrary, it is much to the credit of American industry that the introduction of television has been delayed until it could be accomplished with safety and satisfaction to the public. Television service might have been started a few years ago, receivers might have been sold, but the performance would have been poor, the receivers would be obsolete and useless now, and the whole investment made worthless. I think that we can be grateful and pleased that the development has been sensible and orderly, the introduction not premature, and the serious problems solved in a few laboratories rather than in thousands of homes.

Time Factor Important

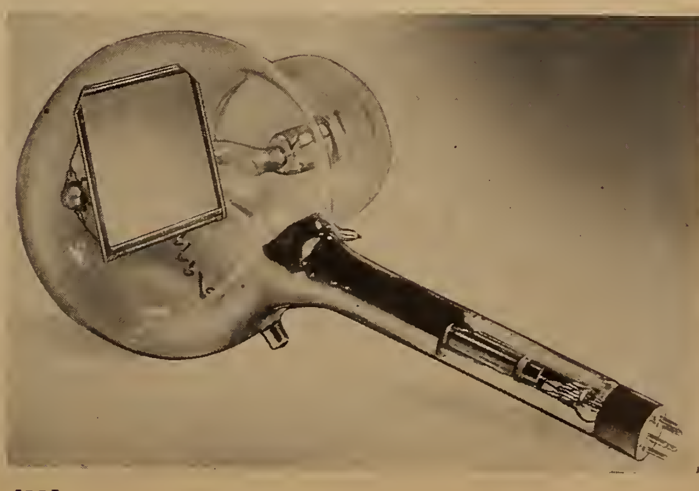
We need to see why the television art is so complex as to require this careful treatment. Why is it so different from sound broadcasting? We have seen sound receivers develop from the simplest crystal headphone type to the complex instruments of today, with no troubles from obsolescence—we have seen transmitters grow from tiny power to 50,000 and even 500,000 watts. Wherein is the difference in television?

The difference is not one merely of degree of complexity of apparatus. A totally new element is present in television, and not in sound broadcasting, namely the factor of time, and infinitesimal divisions of time at that. At the transmitter we have in effect to take pictures and send out descriptions of these pictures, bit by bit, and at the receiver we must put these bits together in the right places, as in a jig-saw puzzle, and at the right time. In other words, there are various actions at the transmitter and at the receiver which must be coordinated accurately. This means that the process involves a *system*—that transmission and reception can not be designed or conducted independently, and each is vitally dependent upon the other.

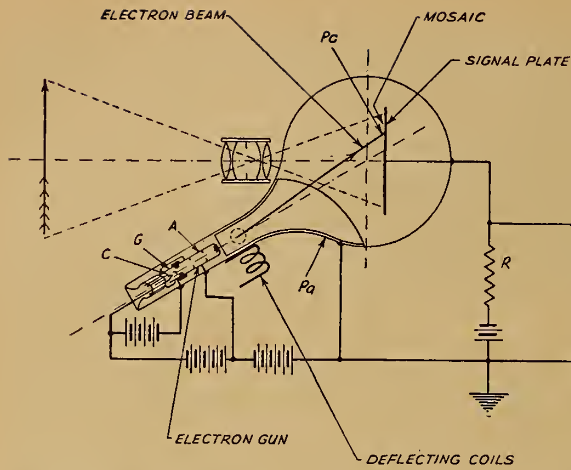
Before we discuss these characteristics, which are responsible for the peculiar engineering problems of television, it will probably be helpful to review briefly the principles upon which the simpler forms of radio communication operate, as this will assist toward clearer understanding of television, the most complex form.

We may note at the outset that there is nothing wireless about wireless apparatus. The wireless part is entirely in the medium between transmitter and receiver. The transmitter and receiver themselves are electrical apparatus fundamentally, like motors, lamps, telephones, and so on. Of course, radio uses some forms of electricity which these other devices do not, but basically it involves electrical apparatus using voltages, currents, power, under the same electrical laws as govern the others.

The function of the radio transmitter is to excite the medium between stations, by means of electric currents which in some way represent the intelligence to be transmitted. The function of the receiver is to detect these disturbances in space, translate them back to electric



The Iconoscope, the heart of the television camera, as used in the RCA system. The plate is scanned 30 times a second by a beam of electrons emanating from the neck of the tube



Schematic of the RCA Iconoscope, which is shown in halftoue on the preceding page

currents like the ones at the transmitter, and then to convert the currents to the form of intelligence which they were made to represent at the transmitter.

Fundamental Transmitter Units

The fundamental parts of the transmitter are the generator, the modulator, and the antenna. The generator generates the particular form of electric currents needed, the modulator controls those currents to represent the intelligence to be transmitted, and the antenna radiates the modulated currents, or their effects, into space.

Considering the generator for a moment, we can note that the only vital difference between it and the generator we use for electric light and power is that its frequency is higher. Where light and power currents have a frequency of sixty cycles per second, the currents used in an antenna have a frequency of thousands and millions per second. When we say that station WEAF has a frequency of 660 Kilocycles, or 660,000 cycles, it signifies that the currents in the WEAF antenna are flowing back and forth from the station generator that many times per second. These high frequencies are used because they radiate from the antenna more efficiently.

The highest frequency used for standard sound broadcast stations is about one and one-half million cycles per second. Later we shall see that television stations use still higher frequencies, of the order of fifty million. And radio laboratories are experimenting with frequencies of over one billion cycles per second!

The modulator is the part which controls the high-frequency alternating currents in the antenna, and modifies them to represent intelligence. If we are concerned with telegraphy, we find that the modulator simply starts and stops the current, in short and long bursts representing dots and dashes of the telegraph code. Therefore the antenna radiates a series of disturbances through space exactly representing the letters by dots and dashes.

If we desire telephony, the process is somewhat more complex. Here the high-frequency alternating current is fed to the antenna continuously without ever stopping, but is varied in strength to accord with the sounds to be transmitted. Here the microphone is used, because its ability is to convert air sound waves which strike it into electric currents which vary in exact representation of the sounds. These microphone currents are used to control, or modulate, the high-frequency currents going into the antenna from the generator, thus causing the antenna currents to be representative of the originating sounds. To complete the story, we may note that the receiving antenna has currents generated in it when struck by the traveling and varying strength space waves, and these currents are caused to actuate a loudspeaker, which is a device to convert electric currents to sound waves.

Severe Transmission Requirements

Note that in both telephony and telegraphy, we have transmitted intelligence by modulating the flow of high-frequency current in an antenna to represent what we wanted to transmit, whether that was words of a message, letter by letter, with a dot-dash code, or whether it was sound occurring in front of a microphone. Now suppose that the form of intelligence to be transmitted is a picture, a drawing, a visual scene of any kind. We must arrange to modulate the same antenna high-frequency current in some way which can represent the picture to be transmitted. And right here we come up against the enormous difference between sight and sound.

In sound, we have to transmit only one thing, one bit of intelligence, one sound, at a time, with others in sequence. A symphony concert, or a Jack Benny program, consists merely of one sound at a time. True, each sound may be a complex one, with various tones composing it, but it is only one sound, and can be represented by one current. An instant later, another sound can be represented by another current, and our signals radio transmitter can follow the progression of single instantaneous sounds faithfully. But a picture, even one instantaneous flash, is not a single thing of any sort, and can not be described or represented by *one* electric current or one anything else. It is composed of many littler elements, one for each area of that size which the eye can distinguish.

For example, if we look at a scene whose dimensions are ten feet square from a distance where the eye can distinguish objects one inch in diameter, there are about fifteen thousand small, one-inch areas which must be described individually to convey the whole picture. If the scene to be transmitted is a stationary one, and we are permitted to take any amount of time to describe the scene, we could do so successfully by an ordinary telegraph system and a simple code. We might divide our scene up into imaginary squares, 100 each way, and number them in sequence beginning with the upper left corner, going across the top row, then beginning the second row at the left, and so on until the lower right small square would be number 10,000.

We will then arrange an understand-

View of studio, showing two television cameras televising a scene in the corner, while a new set is being prepared in another corner

ing with our correspondent that we will telegraph him a message containing ten thousand numbers and that the numbers will be the digits one, two, or three. One will mean white, two will mean gray, and three will mean black. Our telegram may then read 11132212333311-23111, *et cetera*, for ten thousand digits. If our correspondent then takes a sheet of paper ruled with 100 squares each way, and fills in the squares by the information we have sent him, he will have the complete picture—when he finishes.

Obviously this procedure is an exceedingly slow one, impossibly so if we desire to transmit pictures of moving objects. But it is satisfactory, with only moderate change, for the transmission of still pictures, or the art known as facsimile transmission. If for example, instead of transmitting numbers by telegraph code, we arrange the transmitter to send out an impulse once each second, let us say—one impulse for each of the little squares in sequence, and the strength of each impulse to correspond to the degree of light in the square it represents, we can send out a description of the picture in 10,000 seconds, or 2½ hours.

At the receiving end we will arrange a printing device to record each impulse in the same order and location which they had at the transmitter, and with an ink intensity corresponding to the current intensity of each impulse. Our chief problem will be that of synchronization between transmitter and receiver, that is, the receiver must make its mark in square No. 1 when the transmitter is describing No. 1, and so on coincidentally throughout the picture. This is the facsimile system, as used on wire and radio, and now in commercial service in various applications. In these services, the performance has been speeded up by several impulses each second, so that only ten minutes or so is required to transmit a picture, rather than 2½ hours.

We can notice, from this requirement of transmitting a simple still picture bit by bit until the whole scene has been covered, that the problem is very different from sound radio where only one thing, one sound, has to be transmitted. The facsimile art, that of transmitting single still pictures, has been developed extensively and well, so that very excellent pictures can be transmitted. Note, however, that a time of several minutes is required to accomplish the transmission of *one* picture.

The Core of the Problem

Now, television, the transmission of moving scenes, really requires transmission of many pictures each second, enough so that, just as in motion pictures, the eye will be deceived by the succession of still pictures into believing it sees a continuous scene.

The motion picture of today shows 24 different lantern slides each second, and that is what we have to accomplish in television, namely, transmit at least 24 different pictures each sound. In other words, we have to send out information about each little element of each picture, repeating the process many times each second. Remembering that the facsimile system takes ten minutes to send one picture, if we need, say, 30 pictures per second for television, we shall have to speed up the process of facsimile by 18,000 times to accomplish television.

There, in a nutshell, we have the primary cause of practically all the television engineering problems. It may be described as a requirement for transmitting an enormous amount of information very accurately in a very short space of time. Let us proceed to examine how it may be accomplished.

Of course we have only light to start with. Any object or scene is visible because of the light waves which reflect from it to the eye. We desire to catch these light beams in a device which will convert them into electric currents which we can use, in turn, to modulate or control the radio currents being fed into the transmitting antenna from a generator. Several ways are known by which to convert the light images to electricity. Two or three different ways were used in early television systems, but the modern system utilizes a device of outstanding superiority, and it is necessary to consider that one only. This device is called the "Iconoscope,"* from the Greek meaning "image observer."

The "Iconoscope" in television corresponds to the microphone in sound transmission. Where the latter converts sound waves to electricity, the former converts light waves to electricity. The "Iconoscope" has two main parts. One is a plate upon which is focussed by ordinary optical means, the scene to be televised. This part corresponds exactly to the plate or film in a photographic camera. Its surface is covered, not with photographic emulsion, but with light-responsive, or photo-electric, cells. These cells are microscopic in size, but each is separate from the others, and each generates electric voltage when light strikes it, with the voltage being proportional to the strength of the light.

Therefore when a picture is focussed on this plate, with various parts of the picture at various degrees of brightness, those tiny cells having no light upon them generate no voltage, those with strong light generate strong voltage, and those with intermediate light generate intermediate values of voltage. It remains to collect these various voltages off of the plate in order to use them. To do this we might have a tiny wire brushing against the plate and sweeping with uniform strokes all over it, thus contacting the whole area bit by bit. But since we must sweep the plate so fast, and so many times per second, it is impossible to devise any mechanical system light enough to be so moved. So the "Iconoscope" utilizes a brush which has no material weight, namely a beam of electrons.

The second main element of the "Iconoscope" is an arrangement for generating this small beam and directing it so that it falls upon the plate in one tiny spot. Other electric arrangements cause this spot to move all over the plate, in regular fashion, line by line. The present standard television system is designed to have 441 of these lines to cover the whole picture from top to bottom. The first systems had only 24 lines. It is clear that the picture will be more accurately reproduced, more capable of showing small details, the greater the number of lines.

Also, of course, the more lines there are the more information about the pic-

(*Continued on page* 29)

*Trade Mark Registered U. S. Patent Office.

The television receiver, with its reflecting mirror in the lid of the cabinet; and the 3 x 4-foot screen upon which the image is projected

ANALYSES OF MODERN THEATRE SOUND REPRODUCING UNITS

By *AARON NADELL*

EVERY sound heard, regardless of make or model, performs eight specific functions. Each item of the complex assembly can be classified according to the purpose it serves. A few parts manage to make themselves doubly or triply useful.

The general, as distinct from the specific, purposes of the head should be reviewed before detailed analysis is undertaken. The sound head provides a path for the moving film. It provides a source of exciting light, which it focusses on the sound track. Here the light is "modulated"—that is, subjected to continuous changes of strength—by being compelled to pass through the varying density, or varying area, of the track. It is then focussed on, or otherwise transmitted to, the photoelectric cell, where its energy is converted into electrical energy. Lastly, the sound current thus obtained is coupled to the external circuits of the system.

In discharging the first of these purposes of its existence, that of providing a path for the moving film, the head performs three specific functions.

Lateral Placement of the Film

1. In the majority of heads, the moving film must be so positioned that only the sound track, and no other part of the celluloid, intervenes in the path of the exciting light. At this point the light is a thin, flat ribbon, from 1/500th to 1/100th inch high and ¼ inch wide. If any of it is allowed to pass through either the sprocket holes or the frame lines, which lie close to the sound track at either side, the strength of the light will be modulated by factors not included in the track itself, and this unintended modulation will be heard as hum.

Since all film does not come from the exchange with the track printed on it in exactly the correct position, all sound heads in which the light passing through the track has been reduced to a ribbon of exact dimensions are equipped with a guide roller or similar means by which the lateral placement of the film can be adjusted.

Lateral adjustment is made in three ways: (a) by listening to the hum, and adjusting the guides until it disappears. This is not a good method, because traces of hum loud enough to be heard by the audience are often inaudible in a noisy projection room. A more practical variation of this method is to have an observer listen in the auditorium and signal the projectionist by means of the sound buzzer. Since sprocket hole hum and dividing line hum do not sound the same, an observer who can tell them apart can signal to have the guide adjusted inward or outward.

(b) By observing the image of the light on the film. This is impracticable in those heads in which the film is held, at that point, by a sound gate which hides the vital part of the track. In the many heads in which it can be done, use of a magnifying glass is highly advisable.

(c) By use of a strip of blank, undeveloped film, which can usually be found at the beginning and end of each reel as received from the exchange. The strip is threaded into the idle head between reels, and the light is allowed to fall on it for ten seconds or so. The machine is then turned by hand to move the blank film along, and a second exposure made in the same way. After from two to six exposures, the strip is removed and examined. It will be found that the light has photographed itself (without any developing) as thin black lines, the position of which will tell at once whether any light has reached beyond the sound track limits. The exposed portions of the film are torn off. to prevent confusion, and new exposures made after the guides have been adjusted. In this way an extremely accurate setting of the guides can be achieved within three or four minutes. If re-positioning is undertaken to accommodate some reel on which the sound track was improperly placed, the results shown on the blank strip are carefully compared with the defective reel.

In the so-called projection type of sound head, light is only roughly focussed on the track; a good deal is permitted to spill over. An objective lens then focusses the image of the illuminated track upon the photoelectric cell. An adjustable slit or frame intervenes in front of the cell. This is shifted

Announcement . . .

Valuable prizes for the best answers to questions based on Nadell article will be awarded each month by I. P.

Beginning with this issue Aaron Nadell will contribute each month an article to which will be appended a group of pertinent questions, replies to which are solicited from I. P. readers. This new feature is not a prize contest in the usual sense of the term; rather does it serve the two-fold purpose of stimulating a keener interest in strictly technical articles and at the same time testing the retentiveness of the reader's memory.

Not less than four questions will accompany each article; and not less than four prizes will be awarded each month, the order of which will be determined by Mr. Nadell and the editor of I. P., who will act as judges. Awards will be predicated on one thing only—the best answer; manner of presentation will count for nothing. The prizes will include valuable and useful accessories—meters, tool kits, buzz tracks, volume indicators, testing aids, etc. At the end of six months a grand prize will be awarded for the best answer received during that period.

Answers should be addressed to the Contest Editor in care of I.P., and must reach I.P. not later than the 20th of each month, following magazine dating. Answers received after the 20th of each month will receive no consideration. Go to it!—*EDITOR.*

to mask out all light except that which has passed through the track. The photographic method just described is not applicable to this type of head. The

RCA variable area track

mask is adjusted by listening for hum, either in the projection room or through an observer in the auditorium; or by observing the mask through a magnifier while a piece of film is in position and the machine is turned over slowly.

The magnifier will show whether an image of a sprocket hole edge or of a framing line is projected on the mask in such position as to overlap the slit through which light reaches the cell. The mask is then adjusted laterally until the only light penetrating the slit is that which comes from the sound track.

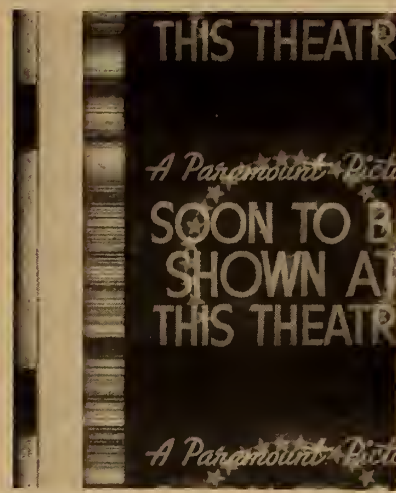
Focal Placement of the Film

2. Since light focussing arrangements of some type are an inescapable necessity, it follows that the sound head must provide means for keeping the sound track at the point of focus. A common projection room experience demonstrates the extent to which this adjustment is critical. Some test films are so made that they can be threaded and operated with the emulsion side of the film facing either way. When threaded the wrong way, the sound track is removed from proper focal placement by the thickness of the celluloid. The loss resulting from this small maladjustment is conspicuous in output meter readings. Yet the displacement amounts only the film thickness, 6/1,000th inch.

In some heads, the film is held in focal adjustment by being made to pass through a sound gate, where polished metal shoes under spring tension press against it. More recent design causes the film to slide over a curved surface, which may be either stationary or rotating. The sprockets, guide rollers or pad rollers of such heads are so placed that the moving film is held firmly against the curved surface, and therefore in focal position.

With either design, wear of the parts or buckling of the film permits the sound track to shift periodically into and out of focal placement. In a sound gate, this may result from wear of the shoes, or weakening of the tension of the springs behind them; in either case the film is held less tightly. Wear of the guide, pad or idler rollers that press the film against a curved surface has the same effect. A buckled (corrugated) film cannot be kept in perfect focal alignment by any mechanism.

Since a departure from perfect focal adjustment shows up readily in sound volume as read by an output meter, it follows that when the sound track shifts periodically into and out of focal placement, volume in the theatre will rise and fall in synchronism. This effect, taking place at a rate of several hun-



W. E. variable density track

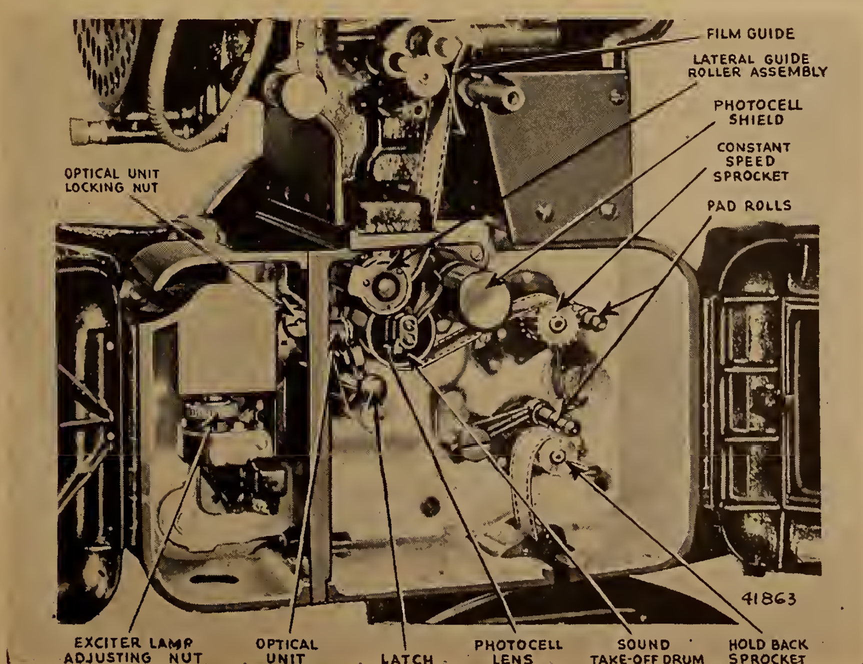
dred (or several dozen) times per second, produces an annoying type of distortion known as flutter. The need for periodic inspection of all parts of the head concerned, and their prompt replacement when they show signs of wear, is obvious.

Control of Film Motion

3. Another and more common form of flutter results from irregularity in the motion of the film through the beam of light. Controls for this motion are built into every head. Nearly all heads move the film in addition to controlling it, but there is one type in widespread use which has no sprockets at all. Film comes down to it from the intermittent sprocket, loops around the sound head controls, and returns to the take-up sprocket of the projector; thence back through the sound head to the lower magazine. In this form of head, steadiness of film motion is insured by the action of the essential control, a rotating drum against which the film presses; in all others the action of a rotating drum or other control cooperates with sound head sprockets in keeping the film pace steady.

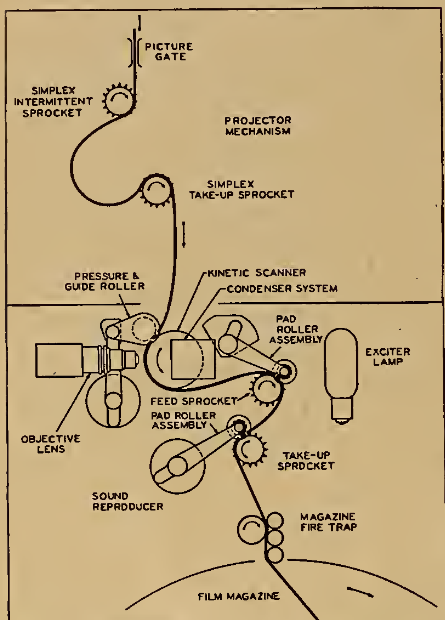
If the speed of the film varies, the striations or peaks of the sound track will pass through the light at speeds other than intended. Since the rate at which the striations or peaks pass through the light govern the frequency of sound, it is plain that when the film moves faster than it should the pitch of all sounds is raised; when the film moves too slowly the pitch is lowered. When the rate of speed changes periodically, a few dozen or a few hundred times per section, all sound will undergo a rhythmic rise and fall in pitch.

This is the most common type of sound flutter, extremely annoying to the audi-



Interior of operating side of modern RCA soundhead, showing principal features

ence. The distortion is such that some tones in speech are masked and lost; some voices are made unnaturally husky; all singers appear to be using vibrato, the tremolo effect that some singers use



Path of film travel in W.E. Heavy Duty (7400) soundhead

intentionally at certain points; piano sound becomes so raspy as to be unrecognizable, as (in fact, the effect is so pronounced that piano recordings are used as test reels to detect slight traces of flutter), and no instrument, voice or noise effect sounds as it should. The result from the point of view of the audience is worse than mere distortion, since untrained ears do not recognize this trouble for what it is. The audience strives unconsciously to identify this unusual effect in things heard, and being unable to do it suffers a continuous subconscious strain. There is no noise or hum or other sound trouble that so mars a show.

Every portion of the sound head that helps move the film or control its motion may cause or contribute to flutter. These include the motor, the connecting gears, belts or chains, sprockets in the sound head, the pad rollers that press the film against the sprockets for the purpose of holding the sprocket holes down against the widest part of the teeth; as well as "impedance pad rollers," rotating drums or other special parts which have the sole function of keeping film motion steady. All these components are subject to wear and, consequently, to imperfect behavior.

Causes outside the head are, chiefly, torn or stretched sprocket holes in the film, which cannot be engaged fully even by the widest part of the sprocket tooth; imperfect action in the take-up, pulling the film down with an irregularity too great to be ironed out by the controls in the head, and excessive vibration in the projector, which may act either by imparting excessive irregularity to the film motion or by so shaking the parts of the sound head that they cannot function properly.

Source of Light

4. The head provides a source of exciting light, a special lamp bulb with a horizontal filament. The filament is so mounted that it will not vibrate (change focus) under the impact of the projector vibration. Unavoidable variations in the placement of the filament within the bulb make focussing arrangements necessary. The bulb can be shifted in three planes, and can be rotated to make the filament face squarely toward the focussing devices. The bulb socket arrangements are nearly always such that spare bulbs can be prefocussed in spare sockets, ready for instant replacement in case of burn-out.

This light is provided only for the purpose of undergoing modulation by the sound track. Any other modulation (change in light strength) will be heard as noise if it occurs at an audible frequency. Therefore the light must be absolutely steady. Direct current is brought to the sound head in most systems, but some use a.c., the frequency of the system being adjusted to reduce the volume at 120 cycles and less, so the a.c. hum will not be heard. Many sound heads mount an ammeter by which the lighting current can be read, and a rheostat by which it can be controlled.

Focussing Light on Track

5. The simplest method used to focus the light into a ribbon of suitable dimensions at the point where it passes through the track consists of an optical assembly containing lenses and a slit formed by two sharp metal edges placed very close together. This slit gives the ribbon of light its shape. The lenses serve, first, to collect as much light as possible, then to focus it on the slit, then to focus the image of the slip upon the sound track.

In some sound heads these assemblies can be focussed and also rotated for azimuth—that is, rotated to bring the slit parallel to the striations of the track. In others these difficult adjustments are made and sealed at the factory.

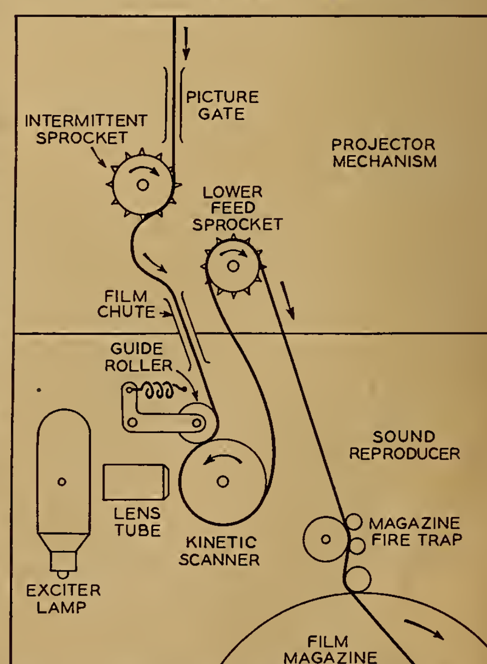
In the most modern heads the same simple optical arrangements must be traced through more complex details of construction. Improvements intended to promote smooth motion of the film were often such that mechanical parts intruded into the straight path of the light; hence, the light path in many modern heads is deflected by use of prisms. In the projection-type of scanning there is no slit between the lamp bulb and the film. The light is only roughly focussed on the track by means of a condensing lens. The other, more accurate optical arrangements are placed between the film and the photoelectric cell.

Because of these variations in modern designs, the problems of focussing are best deferred until the complete path of light has been traced.

Transmitting Light to Cell

6. The sound head provides facilities by which the light that passed through the track is made to impinge upon the photoelectric cell. In the simpler heads this amounts to no more than an unobstructed path. In the more intricate arrangements prisms or lenses bend the light around intervening obstacles. In projection scanning a compound objective lens of the type used in microscopes is placed between the track and the cell, and is focussed on the track. The light leaving the objective is picked up by a collimating or collector lens and thence thrown against the cell. The beam of light is given its ribbon shape, not before it passes through the track, but afterward, just before it enters the collimating lens. The effect is the same.

All these optical systems are adjusted primarily by positioning the exciter lamp bulb. Some, not all, provide supplementary adjustments at the lenses or the slit. It will be remembered that focal displacement of the sound track by as little as 6/1,000th inch produced a distinctly noticeable loss. An equal maladjustment of focus originating anywhere



Path of film travel in W.E. Standard (211E) soundhead

in the optical system will have the same effect.

Focus is adjusted by sight, hearing and measurement. The commonest sight adjustment introduces a white card or paper

directly in front of the photocell. A clear white oval is seen when focus is perfect with no film in place. Red, blue or brown light, or distortion of the shape of the oval, indicate various defects in the focus, calling for further adjustment.

Focus may be roughly adjusted by listening for the loudest volume and for crisp sound. The measurement method calls for use of an output meter and a loop of test film on which a high frequency (specified by the sound head manufacturer) has been recorded. Focus is adjusted to give maximum volume with that frequency, and is then correct for all lower frequencies.

The visual method checks discoloration of the light by oil. Oil on any of the lenses, or on the bulb of the exciter lamp, gives a yellowish cast to the light. It is rubbed away with lens tissue, either dry or moistened with Carbona. Oil often seeps into sealed optical assemblies. Some of these can be opened and cleaned in the theatre; some cannot, and must be returned to the manufacturer for cleaning.

Projector vibration picked up by any loose portion of light system, lamp filament, lenses or slit, is a fruitful source of noisy sound, since it produces recurrent misadjustment of the focus.

The most modern heads are adaptable to push-pull film, which contains two half-width sound tracks side by side instead of a single full-width track. The beam of light may be split into two beams by lenses or lens-prisms; each beam then impinges separately on one track, and is then passed to one cathode of a push-pull photocell. In the projection method, a single beam traverses both tracks, but is split into two beams by a septum (partition) at the framing slit. In all cases some simple adjustment provides conversion between push-pull and single track scanning.

Converting Light Into Current

7. The light, more accurately its energy, must be converted into electrical energy for amplification. The sound head provides the converter, which is the photoelectric cell.

Only one kind of cell need now be considered, the selenium type having just been discarded by its only user. The now universal type contains a cathode coated with the metal caesium. This metal has the property of emitting electrons in proportion to its illumination. Electrons are emitted in varying quantities under the influence of the modulated light that reaches it from the sound track. The cathode is connected to the negative terminal of a steady, d.c. voltage source. An anode (physically small, so it will not shadow the cathode) is connected to the positive source. The emitted electrons are attracted to the anode, constituting a flow of current across the cell and through the external circuits.

The cell is not a vacuum but is filled with a chemically inert gas. The gas, by ionizing under electron bombardment, multiplies the cell's sensitivity by ten. Its presence, however, rigidly limits the polarizing voltage that may be used. This voltage runs from 90 to 125, according to manufacturer's specifications. Excess voltage will cause the gas to glow through excessive ionization. A cell once caused to glow may be permanently impaired. On the other hand, cases are known where causing a cell to glow permanently improved its sensitivity.

In modern heads, the cell is built like a radio tube and held in position by insertion in a standard tube socket. The "window" portion, through which light must enter to reach the cathode, is kept clean of oil by wiping with lens tissue, either dry or moistened with Carbona.

The Output Coupling

At this point the sound head has completed most of its work. It has provided a source of light and has focussed it successively on a framing slit, on the film, and on the cathode of a photoelectric cell. It has moved the film smoothly and in correct position through the focal point in the light path, thus modulating the light input to the cell. In the cell it has converted the light energy into modulated direct current which, in its successive changes of strength, represents an exact reproduction of the frequency (pitch) and extent (volume) of the successive changes of transparency recorded on the track. All that remains to be done is to couple the modulated direct current into the external circuits where it will be amplified.

The strength of this current governs the coupling means used. The emission of electrons in a photoelectric cell is very small even under the brighest light, and the output current is of the order of 1/1,000,000 ampere. The coupling or matching resistor through which it completes its path is commonly one megohm, giving a potential difference across that resistor of one volt: one volt at one microampere representing, of course, an output of 1/1,000,000th watt in a line of high impedance. It is not practicable to run a line of such impedance, carrying such low power, across a projection room to the amplifier, nor to insert switches in such a line for change-over between projectors.

One common method of coupling is to use a transformer, stepping down to a low-impedance line. The transformer primary may be connected either in parallel or in series with the coupling resistor. The low-impedance line from the transformer secondary (usually 200 or 500 ohms) may be run through the change-over switch to the system amplifier; or may run to a pre-amplifier mounted on the front projection room wall, and thence through the change-over switch.

A second method is to mount the system amplifier on the front wall between the projectors and to connect the photocells to it through a very few feet of thoroughly shielded cable. The cable commonly used is the coaxial type, in which the grounded shield constitutes the negative conductor, and the insulation between the shield and the central positive wire is an inch or more in diameter (to keep the capacitance low).

A third method, now abandoned by all manufacturers but still in widespread use, is to mount a pre-amplifier of one or more stages in the sound head itself, immediately adjacent to the photocell. A variation of this method keeps the pre-amplifier in the same position, but supports it on a pedestal stand rather than by the sound head casing, in order to avoid projector vibration. Such amplifiers may be equipped with rheostats and meters to control their filament current.

Whatever coupling method is used, the low order of the power output makes unusual electrical precautions imperative. Shielding and grounding must be thorough; connections tight, and insulation fully protected against lubricating oil from the projector. Where such protection is less than perfect, the oil-soaked wires become noisy and must be renewed periodically. Some sound head amplifiers are so completely shielded against oil that they are practically inaccessible in their amplifier compartment, and must be disconnected and removed for the simplest repairs.

Here are the Contest Questions—

1. How are sprocket hole noise and dividing line noise distinguished by listening to them? Which sound has the higher pitch?

2. If a trouble lamp is used to inspect the sound head during operation, and the light is allowed to reach the photocell, will there be any effect upon the sound?

3. If an exciting lamp is kept in use after its filament has sagged, will the effect be the same with both variable density and variable area tracks?

4. If sound from one projector is noisy because of vibration (*i.e.*, quiet when checked with projector motionless), how can the cause be found and eliminated?

Some General Principles of Projection Optics

By *R. Howard Cricks*

WHENEVER rays of light pass at an angle from one substance to another of different density, they undergo *refraction*, or bending. We know that a stick placed in clear water will appear to be bent at the surface of the water. The substances with which we are chiefly concerned in optics are glass and air.

In the case of a simple lens, rays of light are bent toward the thicker part of the glass. There are several types of simple lenses, as shown in Fig. 1. A plano-convex (A), bi-convex (B), or a meniscus (C) *converge* the rays of light; while a plano-concave (D), bi-concave (E), or concavo-convex (F) *diverge* them.

The *focus* on a single lens is the distance at which it must be placed from an object for the rays refracted from that object to become parallel, or, as it is expressed, to form an image at infinity. This is shown in Fig. 2A. As the lens is moved farther away from the object, the image will be formed closer to the lens (Fig. 2B), until (as in 2C) a point is reached where an image the same size as the object will be formed at the same distance from the lens—the distance being equal to twice the focal length. These points are known as *conjugate foci.*

If the object of size O is at a distance F from the lens, and the image is formed at a distance D, the size of the image will be given by:

$$W = \frac{O \times D}{F} \quad \text{....(Formula 1)}$$

Applying this formula to a motion picture projector, where we have a film image width of .825 inch and a lens of focal length F inches, at a throw of D feet, the width of picture W in feet will be:

$$W = \frac{.825 \times D}{F}$$

If two convex lenses are used together, the combined focus will be shorter than the focus of either lens singly. If we have two single lenses of focal lengths F_1 and F_2, separated by a distance D, the combined focus F becomes:

$$F = \frac{F_1 \times F_2}{F_1 + F_2 - D} \quad \text{........(Formula 2)}$$

Certain projector lamphouses provide focussing adjustment of the condensers, and it will be seen from Formula 2 that bringing the condensers closer together will shorten the combined focus. This is the principle employed in variable focus lenses.

The size of image as obtained from Formula 1 does not necessarily correspond with the measurement of the distance from object to lens when a compound lens is used. We therefore use the term *equivalent focus* to indicate a compound lens which will throw an image of the same size and at the same distance as a simple lens of the given focus. That is to say, a lens of 5-inch equivalent focal length will give the same size picture as a single lens of 5-inch focus.

Aperture of a Lens

Obviously the diameter or *aperture* of a lens controls the amount of light which it will pass; this is also governed by the focal length, and is measured by dividing the focus by the diameter. Thus a lens of aperture $F/2$ with a focus of 6 inches must have a stop diameter of 3 inches. A lens of $F/2$ will pass approximately four times as much light as a lens of $F/4$; but on the other hand, it will have only half the depth of focus, which in our particular case means, for example, that a film buckle which puts the picture off the focal plane will show up twice as badly on the screen with an $F/2$ lens as with an $F/4$.

All lenses suffer to a greater or less extent from certain faults. All simple lenses show spherical aberration, in which, due to the fact that rays of light striking the lens near the edge will be

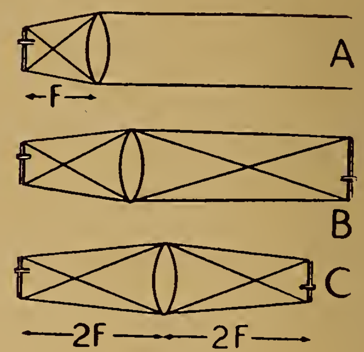


FIGURE 2
Explanation of lens focus

refracted to a greater extent than those near the center, it is impossible to obtain sharp definition.

Another common fault is *astigmatism*, which means that different parts of the image do not come to a focus in the same plane, as shown in Fig. 3. A lens may distort the image toward the edges, giving either *barrel* or *pincushion* distortion, which terms are self-explanatory. Another defect is *coma*, when the image cast by the lens appears to be shaded toward either the center or the edges.

In practice, then, the image formed by a lens must always be more or less out of focus; in other words, the image formed by the lens of an infinitely small point cannot be a point but is diffused into a circle, which is known as the *circle of confusion*. In a high-grade lens, however, this circle of confusion may be so small that the eye cannot see it—the *resolving power* of the eye is not sufficient.

Photographic emulsions have a considerable graininess, by reason of which their resolving power is limited; this point is actually the restricting factor in the recording of high frequencies in the sound track.

White light consists, of course, of seven primary colors; and these primary colors are unevenly refracted by glass, to a different extent according to the type of glass. This defect results in color fringing in the picture (that is, the appear-

FIGURE 1
Types of simple lenses

ance of little rainbows around the edges of bright objects), unless the lens is rendered *achromatic* by forming it of various types of glass so selected that light of all colors will be refracted evenly.

The modern projection lens, then, consists of two combinations each composed

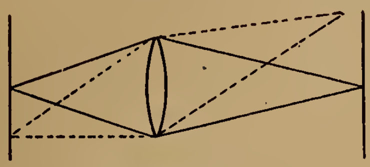


FIGURE 3
Explanation of astigmatism

of two or three individual lenses of different qualities of glass, generally cemented together. (In several recently produced lenses, however, the balsam or cement has been omitted, as it tends in the course of time to discolor.) Standard projection lens diameters are 1 11/16 inches and 2 1/16 inches; but in addition, modern lenses are made in large diameters up to 4 inches, maintaining a very high F value—often $F/2$ or larger —even on the longer foci.

Cylindrical Lenses

If a lens has a cylindrical curvature —that is to say, instead of being like a piece cut out of a ball, it is like a piece cut out of a round rod—it will concentrate rays in one direction only if the other side is flat or *plane*. If the other side is curved, it will produce an oval instead of a circular spot of light.

This principle is occasionally used in condensers to project an oval spot of light on the projector gate to suit the rectangular shape of the film picture. Cylindrical lenses are also used in optical systems for recording cameras to concentrate the image of the recording light upon the slit.

Anent the Mirror Arc

The fundamental law of reflection states: "The angle of reflection is equal and opposite to the angle of incidence"; which means, in simple language, that a ray of light falling upon a reflecting surface will be reflected back at the same angle, but on the opposite side of the perpendicular.

In the case of a spherical mirror it will be seen from Fig. 4 that according to this law the focus of the mirror, *i.e.*, the point at which an object must be situated to reflect parallel rays of light, is exactly half the radius of the curve; the two angles indicated are then equal.

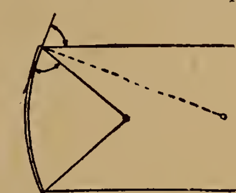


FIGURE 4
Focus of spherical mirror

The chief application of mirrors in projection is in the mirror arc, where various curvatures are used with the object of obtaining an even distribution of light upon the projector gate.

EX-ERPI EMPLOYEES ORGANIZE ALTEC CORP., AND TAKE OVER ALL SERVICE CONTRACTS

ALTEC Service Corp. is the name of the new theatre sound servicing organization which, as assignee of all Erpi service and deferred payment sales contracts is already conducting servicing operations throughout the country in eight district offices and numerous branch offices. Practically the entire Altec personnel, at the home office and in the field (but excluding certain financial backers) are ex-Erpi employees. However, the divorce from Erpi and every other unit of A. T. & T. is definite, final and conclusive.

Altec will pay off A. T. & T. for the contracts under a liberal time-payment plan extending over a number of years. Altec is strictly on its own, therefore, although there is little outward semblance of change, due to long advance planning for just such a move.

Executives of the new company, all of them ex-Erpi men, are L. W. ("Mike") Conrow, president; G. L. Carrington, v.-p. and general mgr.; H. M. Bessey, sec.-treas.; E. Z. Walters, comptroller; Bert Sanford, sales director, and Stanley Hand, staff rep. District managers are L. J. Hacking, Boston; W. W. Simons, N. Y.; E. O. Wilschke, Philly; A. Fiore, Atlanta; O. Hunt, K. C.; R. Hilton, Chicago; F. C. Dickely, Detroit, and L. W. Dodge, L. A. Majority stock interest in Altec is held by Messrs. Conrow and Carrington.

G. L. Carrington

L. W. Conrow

Bert Sanford

Conrow plans an immediate expansion in anticipation of increased business. The present emergency stock points operated from eight branch offices will be increased to forty-two, and each stock will be augmented to provide protection for any emergency arising in the particular area covered by that stock. A new laboratory with all of the latest scientific facilities now under construction in East Newark, N. J., is planned as a liaison between the technical field force and Bell Laboratories. It is being staffed by a group of sound system specialists. Altec executive offices are at 250 West 57th St., N. Y. City.

Having just concluded a pact with the I. A. for all its service personnel who enter and work in theatres, Altec is out to grab all the sound system servicing business it can. In addition, it will continue to collect on the old Erpi deferred payment equipment contracts, for which Erpi will pay a small charge.

Separate Deal on Service

Altec has also made a deal with both National Theatre Supply and Motiograph whereby these companies, which were recently licensed by Erpi to manufacture under W. E. patents, will sell Altec service, on a 10% commission basis. This confirms the exclusive I. P. report that neither of these licensees wanted any part of service operations. When either licensee has an installation job, Altec will supply engineering personnel, irrespective of whether the house carries an Altec service contract. Apparently everybody concerned both gives and takes a little.

The status of the Altec servicemen, who must join I. A. projectionist locals in their respective territories, is discussed elsewhere herein.

Conrow emphatically states that Altec service will match in every particular the best efforts of Erpi in the past, in addition to which he promises to develop intensively new measuring apparatus and other aids designed to increase the efficiency of the field staff.

Decision Rendered on Battle of Split Seconds Anent Frame Aperture Rest

SUCH a tumult! And about what? Why, merely about a statement, made casually and unsuspectingly, by Herbert (Simplex) Griffin in a recent contribution to these pages.[1] Said Mr. Griffin, among other things: "Anybody can figure the number of tons the projector cam pin, star slots and sprocket teeth handle, when it is considered that an eight-ounce tension is always applied at the gate, and the picture must be moved from rest to the next picture in 1/96th of a second."

Subsequently, in a rougish moment, I. P. posed the question: "A single film frame is stationary in front of the aperture 1/32 second. The picture is exposed to the screen in two periods each of 1/96 second, making a total screen exposure of 1/48 second. Do you know how these figures are obtained?"

This query precipitated a precipitation, as they say in Hollywood when it rains steadily for three days. The replies to this question exceeded in number and variety those incident to any similar situation within our experience in the projection field. Appended hereto are a few representative answers and, finally, the comments of Mr. Griffin, author of the article responsible for the ruckus:

A Few Choice Opinions

To the Editor of I. P.

The answer to your question in the Nov. issue (p. 5), is not entirely correct. You say: "A single film frame is stationary in front of the aperture 1/32 second. The picture is exposed to the screen in two periods each of 1/96 second, making a total screen exposure of 1/48 second."

You are wrong in the first part of the foregoing. At the rate of 90 feet per minute, the time each picture remains over the aperture is 1/24 second *less* the time it requires to move the film down (the Simplex intermittent movement being a 4-to-1, or 72-degree, movement), which is 1/5 of 1/24 second, or 1/120 second.

Therefore, at the rate of 90 feet per minute, a single film frame is held stationary at the aperture for 4/120, or 1/30, second, and the other 1/120 second is consumed in the removal of one frame and the substitution of the next frame. Hoping you will credit me for this correction,

WALTER FINK
Local 218, Pottsville, Pa.

To the Editor of I. P.

If the film runs at a speed of 1440 pictures per minute, or 25 pictures per second, the answer to the question relative to how long a single frame is at rest is 1/24 second, and not 1/96 second, as stated in Griffin's article. Where is the catch?

S. ROBBIN
Chicago, Illinois

To the Editor of I. P.

Here is my slant on the aperture question: The shutter travels one revolution in 1/24 second, and during this time a frame is pulled down and exposed. I assume a two-blade shutter is used in which the blades and exposure openings are all equal.

As the cut-off blade passes the lens the movement pulls down a frame of film. Since the cut-off blade represents ¼ revolution, then the pull-down time is ¼ of 1/24 second, or 1/96 second.

The film remains stationary for the balance of the revolution which takes 1/24 minus 1/96, or 3/96 second. This would be the time for exposure, if it were not for the other blade, which cuts off an additional 1/96 second, leaving only 2/96, or 1/48, second as the total screen exposure.

JACK LEATHERMAN
Jacksonville, Florida

Mr. Leatherman is the only one of several score men to turn in the correct answer to our query. For this he will receive gratis—a one-year extension of his I. P. subscription. Mr. Fink, alas, can receive no credit for his effort, because the Simplex intermittent movement is 90-degrees, not 72-degrees, as stated by him. Mr. Robbin might have solved the problem had he not misinterpreted the original article, which did not state that a single frame was *at rest* for 1/96 second, but rather that it moves from rest to the next frame in 1/96 second.

All of which brings us back to Herbert Griffin, the original culprit in this deal. Here is his contribution to the festivities:

To the Editor of I. P.

The intermittent movement, composed of the cam and pin and star wheel assembly, is a 90-degree movement. The film moves at 90 ft. per minute; or 90 multiplied by 16 (frames per ft.) equals 1440 frames per minute; or divided by 60 equals 24 frames per second. The cam and pin revolve 24 times per second, and at each revolution turn the star wheel 90 degrees, pulling the next picture into frame. Thus the cycle takes place in 1/24th of a second.

However, since the movement of the film takes place in only ¼th of the cycle, the 1/24th of a second must be divided by 4, which equals 1/96th of a second; and the picture is stationary in front of the aperture plate for the rest of the cycle, which equals 3/96ths or 1/32 of a second. So much for the intermittent movement.

But now we have the period of exposure to the screen to consider. All standard projectors today are equipped with two-blade shutters, one of which cuts off the light from the screen during the period in which the picture is being pulled down. This, as has been pointed out, is 1/96 of a second, and the normal exposure to the screen, therefore, would be the same as the period of rest, *viz.*, 1/32 of a second.

Since it is necessary, however, to introduce a second blade, called the balance blade, to eliminate flicker (this blade being of equal dimensions to the cut-off blade), another 1/96 of a second exposure is chopped off from the screen, leaving only 2/96, or 1/48, of a second as the final screen exposure for each frame of film.

It undoubtedly will interest your readers to know the basis upon which my statements in your August, 1937, issue were predicated.

[1] "Projector Mechanism Tolerances and Intolerances," I. P. for Aug., 1937, p. 15.

S. M. P. E. Discussion On New Aperture Proposal

NOW available is a copy of the discussion incident to the report of the Projection Practice Committee to the most recent convention of the S M. P. E. Open discussions of this nature are invaluable in focussing attention upon the salient features of such presentations and serve to clarify those points which may not have been sufficiently emphasized. Since this report was published in I. P.,[1] excerpts from the discussion thereof should prove of interest. The discussion:

MR. GOLDSMITH: This recommendation of the Committee (to reject the Academy aperture proposal), was arrived at not only at one meeting but at a special meeting which ran for many hours and considered it in great detail; and then again during the preparation of the report, which took many more hours of the time of a special committee that drafted it, after which it was approved. It probably represents as careful thought, as unanimous opinion, as we have yet been able to give any similar subject. In our deliberations, practical theatre men, active projectionists, supervisors of projection, and engineers, all reached the same viewpoint without difficulty. There was not, so far as I know, a dissenting voice at any time.

MR. CRABTREE: I think the intent of the Academy recommendation is good. They are

(*Continued on page 26*)

[1] "S.M.P.E. Projection Group Rejects Academy Increased Aperture Plan," I. P. for Oct., 1937, p. 12.

The Elements of Vision—The Basis of Projection

By *W. C. KALB*
ENGINEERING DEPARTMENT, NATIONAL CARBON COMPANY, INC.

THE motion picture industry has achieved its phenomenal growth by creating in the minds of its millions of patrons the illusion of reality. What the patron actually sees is a rapid succession of shadow patterns, of gradually changing form, projected onto the screen before him. Were this his mental impression of what he sees, he would never return to see another picture. Fortunately, it is not. So excellent is the illusion that, even though he may know exactly what he is observing, he sees in his mind's eye living people moving and speaking before him.

Since the motion picture industry owes its very existence to this illusion of reality and is largely dependent, for further progress, on still greater realism, it is well to analyze some of those elements of seeing which help to create this reaction in the mind of the theatre patron. Such discussion does not involve "going high-brow." It is just a matter of seeking the source of this favorable mental reaction and determining how that knowledge can be used to yield greater box-office returns. Obviously, favorable reaction is brought about principally through the process of vision.

Form Embraces 3 Dimensions

Light is the medium through which impressions of form and color are conveyed to and registered upon the eye. Vision is usually directed toward objects which are not in themselves sources of light but which are made visible by illumination received from some source of light and reflected to the eye. Except when vision is directed toward the source of light itself, there are always three elements in seeing: the eye, the object observed, and the light which makes vision possible. This is *the triangle of vision.*

Impressions of form embrace three dimensions: height, breadth and depth, using the latter term in the sense of distance from the observer. As an object or scene is observed, the impression of depth or distance is produced in three principal ways. First is the apparent converging of parallel lines at increasing distance from the observer, or, otherwise expressed, the reduced scale in which the image of an object is reproduced in the eye as its distance from the observer becomes greater.

The second method by which impressions of depth and distance are produced is by means of shading and shadows. For example, the impression of curvature, toward or away from the observer, is conveyed to the eye through the gradation of shadow which results from the changing angle of reflection.

The third source of the sense of depth or distance lies in the slightly different angle from which the two eyes of the observer view the same object. This convergence of lines of vision is greater for objects near at hand than for those at a distance, and, because of this fact, we are able to judge distance with a substantial degree of accuracy.

In the pictorial representation of objects and scenes on a plane surface, where all actual design is limited to two dimensions, impression of a third dimension is given by simulation of one or more of the three effects just described. In a line drawing, outlines convey the impressions of height and breadth of the objects illustrated; while perspective, or reduction of scale with increasing distance, creates the impression of depth. This is the simplest and least realistic method. The addition of shading gives much greater realism to the line drawing.

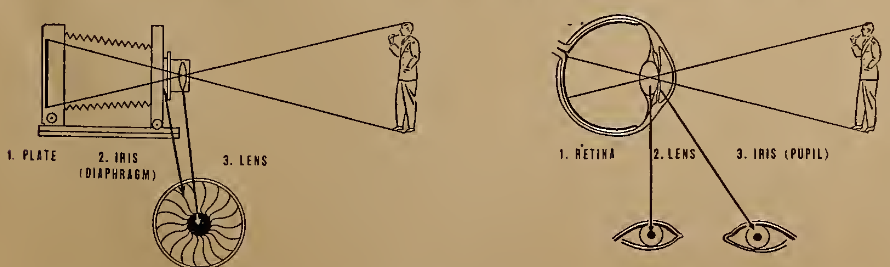
In a photograph there is complete departure from the line except as it constitutes an integral element of the scene or object photographed. Impression of all three dimensions is created by shading or gradation of gray tones, from pure white in the extreme high lights to black in the deepest shadows. The more accurately these gray tones reproduce the visual reaction to the object photographed, the more realistic will be the impression created by the photograph. Further realism is given to the impression of depth by the perspective inherent in the optics of photography.

The third means of giving impression of depth may also be simulated on a plane surface by stereoscopic effects. This method has been used, to a limited extent, in the showing of motion pictures, but, since it necessitates some means for producing differential vision in the two eyes of the observer, its extensive use seems unlikely to be realized in the immediate future.

Prime Requisite For Movies

One requisite for maintaining the illusion of reality in the presentation of motion pictures is clearness of vision. During recent years extensive investigations of the vision of people in all walks of life have been made. The results of these surveys indicate that well over half of the individuals composing the average adult audience are effected by some defect of vision. Such patrons are almost certain to be the most critical of any condition affecting clearness of vision. Interior decoration of the theatre, general illumination and projection of the picture should, therefore, be designed to give the greatest possible comfort and satisfaction to this majority group. In determining how this is to be done there is need to consider four factors affecting vision: these are *brightness, size, contrast and speed.*

Since light is the medium through which the picture is made visible, brightness, *i.e.*, the amount of illumination per unit of area, is of first importance in assuring clear vision. Recent years have witnessed a marked change in our ideas



The human eye works just like a camera. Sharp, clear pictures, in both camera and eye, depend upon the action of the iris. In the camera this is called the diaphragm; in the eye it is called the pupil. Both work on the same principle

of what constitutes sufficient brightness. Abraham Lincoln may have studied in the dim and flickering light of a log fire, but none of us would permit our children to subject their eves continuously to such abuse. Our ideas of what degree of screen brightness is most desirable are undergoing a like change. Screen brightness of 7 to 14 foot-lamberts* is now recommended as a minimum for satisfactory projection. At lower levels there is insufficient light for the eyes of some of the patrons present.

All the light you get on the screen must come through an aperture this size. The area of a 13 x 20 ft. screen is 75,000 times the area of the aperture

Size is also of importance in relation to clearness of vision. The smaller the detail observed, the more light required. It takes more light to read a name and number in the telephone directory than it does to read the large type in a book or the figures on the wall calendar. The size of the image in the eye is affected by distance. Therefore, details of motion pictures which may be seen from front-row seats with relatively dim projection light, require more light to be seen as easily from the back rows.

Contrast is a factor calling for careful consideration in the theatre. The human eye adapts itself to the average level of illumination before it. When there is an excess of illumination the pupil of the eye contracts and reduces the amount of light admitted. When the light is dim, the pupil expands to admit a greater portion of the light reflected toward it. But this reaction is slow. When a patron enters a theatre from a brilliantly lighted street, the pupils of his eyes are contracted and only gradually expand under the dim illumination of the interior. If the general illumination within is too low, his eyes do not receive enough light for vision and he must undergo the discomfort and inconvenience of groping and stumbling to his seat. General illumination within the theatre should be at a high enough level to reduce the extreme contrast with outside illmination so often encountered.

A dark interior is not needed for clear vision of the picture when the level of screen illumination is high enough to provide a substantial degree of contrast between the light on the screen and that on surrounding areas. In fact, it is coming to be recognized that wide contrast between the brilliant screen and the darker background immediately adjacent to it does not contribute to eye comfort. Sharp contrasts in the illumination of immediately adjacent areas is disturbing to vision, and, if sufficiently great, creates the impression of glare. Brilliant screen illumination need not result in glare if the level of general illumination is high enough. An outdoor scene may produce no sense of glare although the level of illumination is many times that of the most brilliant screen.

It has been pointed out that a photograph is a pattern of gray tones, ranging from white, through deepening shades of gray, to black. The quality of projection is determined in large measure by the accuracy with which the gradation of tone in the original photography is reproduced on the screen and recorded by the eyes of the audience. We all know that, when looking at a landscape, details grow dim as evening comes on, until, just before complete darkness, only outlines are registered upon the eye. It is the same on the screen. Too little light results in loss of detail in the picture. There must be enough projection light for the eye to register the full range of contrast, from white to black, and accurately differentiate between the intermediate shades of gray, which give the picture its real beauty, and the illusion of three-dimensional effect.

The human eye is much like a camera. It has a lens to focus the image, an iris or pupil to control the amount of light admitted, and a retina to record the mental image as the emulsion records the image on the film in the camera. Speed bears the same relation to vision that it does to photography. With more light, a photograph can be taken with shorter exposure, and the eye can record a clear mental impression in less time. When viewing a motion picture each frame is before the eye for two brief flashes of 1/96 second duration. In this brief period the eye can scan only a small portion of the visual field presented by one frame of the picture. Due to the persistence of vision, however, the image recorded by each frame remains for a short time after the light is cut off by the shutter, and is augmented by the images of succeeding frames.

Brighter screen illumination enables the eye to see faster, to scan a greater portion of each frame and to build up a stronger and clearer impression of the picture on the screen. Three to four times as much light is needed to see a motion picture as clearly as a still picture where there is no interruption to the process of vision. Poorer and older eyes need still more light. There should be light enough for the poorest and slowest eyes in your audience.

Many Screens Poorly Lighted

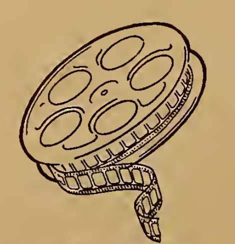
The need for a higher level of screen illumination in most theatres has been recognized for some time. The larger theatres have obtained greater screen brightness by the use of high-intensity projection lamps. This has educated theatre patrons to the increased comfort of vision resulting from a brighter screen image, snow-white projection light and a more satisfactory level of general illumination. The small theatre, however, can afford neither the investment nor the operating cost of the high-power, high-intensity lamps, which have proved so advantageous to the large theatre.

To meet the need of the smaller theatre, the Research Laboratories of National Carbon Co. developed a new type of high-intensity carbon, known as "Suprex" and cooperated with lamp manufacturers in the development of lamps of simpler construction, fewer parts and lower power consumption than the high-intensity lamps used by the large theatres.

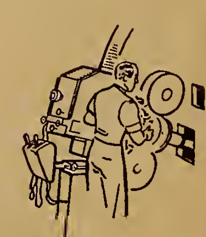
This development has been aptly termed "Simplified High-Intensity Projection." At a very small increase in

(*Continued on page* 26)

The eyes of the audience are already made



The motion picture film is already made



But you make PROJECTION at every show

Light is the only element in seeing that can be improved at will. Projection is the only element in the motion picture process which the theatre controls.

*The *foot-candle* is a unit of illumination, and is concerned with the quantity of light *striking* a surface. The *foot-lambert* is a unit of brightness, and is concerned with the quantity of light *leaving* a surface in a given direction. If a *perfectly* reflecting and *perfectly* diffusing surface were illuminated to an intensity of 1 foot-candle, it would have a brightness of 1 foot-lambert. Illumination values given in foot-candles, then, can be converted to brightness values (foot-lamberts) by multiplying the illumination by the *reflection factor* of the surface. The factor would be about 75 per cent for a good diffusing screen.

The IP EDITORIAL PAGE

Vol. 12, No. 12 DECEMBER 1937

A New Deal in Sound System Servicing

Signaturing of the pact between the I.A.T.S.E. and the newly-formed Altec Service Corp., assignee of all Erpi service accounts in the theatre field, forecasts the 100% unionization shortly of all servicemen who work in theatres. That the I. A. will move speedily to bring into line RCA and all the independent theatre servicing groups that have sprung up within the past five years is a foregone conclusion; anything less would be manifestly unfair to Altec, which has agreed to observe union working conditions and scales. Several aspects of the Altec-I. A. deal are extremely interesting to projectionists.

The deal provides for two wage scales: $80 weekly per man for those whose activities are confined to a given local union jurisdiction, and $110 weekly (pink contract rate) for those whose work cuts across jurisdictional lines. All Altec servicemen will immediately join the I. A. through affiliation with local unions in their respective localities. A nominal entrance fee will be imposed, it is understood. None of these servicemen will be eligible for regular projectionist jobs, it is said, although their 100% bona fide union membership status would seem to make enforcement of this injunction a bit difficult. While few, if any, of these servicemen hold projectionist licenses, either municipal or statewide, a great majority of local unions require such a license as a condition of membership. Will these local unions alter their by-laws? Another question being asked is whether the serviceman's union membership will qualify him to serve as a stand-by man when sound picture equipment is either repaired or installed. These stand-by assignments have been a source of considerable revenue to union men in the past.

None of these obstacles, if they may be termed such, appear unsurmountable. A very ticklish situation is that relating to jurisdiction, wherein not only the I. A. and the company will be involved but also the serviceman himself, who will be vitally concerned about whether he is to receive an additional $30 weekly. Obviously, the serviceman himself will be an important check on any infractions of regulations. It is assumed that the drawing of jurisdictional lines will simmer down to a proposition of give-and-take. On the score of union by-laws, it is doubtful if any union would decline to suspend such provisions as may impose any difficulty in the way of settlement of this matter. The questions of stand-by qualifications and the apparent right of any member to take a projection job require considerably more brow-knitting.

Probably the toughest knot to unravel in the deal is the future of the servicing groups organized by the unions themselves during the past few years, notably in Cleveland, San Francisco, Cincinnati, St. Louis and several other representative I. A. units, most of which at present hold contracts for sound equipment servicing. Will these union groups be permitted to continue operations, strictly as a union activity in competition with Altec and such other service companies as may sign I. A. contracts? or will they be abolished and their accounts be considered fair game for any unionized service outfit? And what if Mr. Exhibitor should balk at relinquishing the union service as now rendered? (Many exhibitors have indicated their preference for such service.) This angle is plenty tough, what with some unions having invested thousands of dollars in servicing equipment and trucks, plus hundreds of hours promotion work. I. P. will not hazard a guess as to the solution of this problem.

The status of these new servicemen members within the various local unions seems to warrant attention. Offhand, it appears that some jealousy on the part of older union members may be engendered by the nominal admission fee and by the wage scales enjoyed by the servicemen: $80 and $110 weekly is money of a kind that few projectionists receive these days. Here is a situation fraught with grave potentialities not only for the success of the unionization plan but also for the future welfare of the unions involved. Several factors justify the wage scales adopted for servicemen: (1) Almost all Altec servicemen, for example, have been averaging $65 weekly. From their future wage scale must come union dues, assessments, death benefits, etc.—all of which will come out of their increases. (2) Higher wages per man undoubtedly will lead to a cut in manpower by the service companies through the medium of adding more theatres to the individual serviceman's burden. Thus, for more pay each man will work harder. (3) By education, training and experience in a highly specialized field the serviceman is entitled to good wages, even though his wage exceed by a considerable margin projectionist scales in his territory. We all know that if projectionist units could have handled this type of work, they would have moved in and taken it over long ago. But they didn't, and that's that. Moreover, these new servicemen members can be and should prove a definite asset to the units with which they become affiliated. Give them a fair shake.

The I. A.-Altec deal represents a logical solution to a very difficult problem, more so as indicative of the early 100% unionization of all servicing units. There is ample credit for all concerned, not excluding I. P. which was the first to focus attention upon the necessity for organizing service workers and which through the past five years has carried on a relentless campaign looking toward the very type of agreement that has now been consummated. But I. P. claims no special credit on this score: it doesn't need it, and such activities are part of its job.

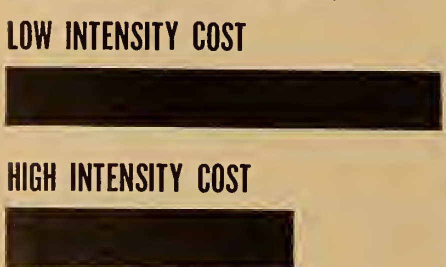
Elements of Vision—The Basis of Projection

(*Continued from page* 24)

operating cost it gives the small theatre two or three times as much light on the screen as the low-intensity projection lamp provides. It permits a safer and more satisfactory level of general illumination. It improves the quality of black-and-white projection, and, due to the snow-white character of the light, gives an accuracy of color reproduction which the yellowish light from the low-intensity arc does not give.

And now, a word about color. Non-luminous objects do not, in a strict sense, have color. If they did, they would look the same to us under any kind of illumination. What they do possess is the property of reflecting, transmitting or absorbing, in varied degree, the colors contained in the light by which they are illuminated. Consequently, if an object is illuminated by a light source that is weak or totally lacking in a certain color, its appearance to the eye will be different than it is in daylight, which is an essentially even balance of all primary colors.

We have come to consider the "true color" of an object as the color it appears to possess when seen in daylight. Recognizing this fact, color productions are photographed either in daylight or under the light from carbon arcs which produce equivalent photographic effects. So great is the color precision of modern photographic methods that color films reaching the theatre today are remarkable for their color accuracy. Color



Comparison of costs for the same number of light units on the screen

undoubtedly adds much to the illusion of reality in motion pictures, provided the colors be true. Only by the use of snow-white projection light, however, can accurate colors be projected onto the screen. The yellowish quality of the light from the low-intensity arc produces color distortion that may seriously impair the realism of the scene.

In the triangle of vision, only one element is under the control of the theatre owner, manager or projectionist. That is light. The eyes of the audience are already made and their perfection or defects beyond the control of members of the theatre staff. The film is received in completed form and nothing more can be done about that. But projection is the product of the theatre itself. Its quality is determined by the judgment used in the selection of equipment and the skill displayed in its operation.

Since patron satisfaction and box-office returns are so greatly affected by the ease, clarity and comfort of vision, the subject of projection and its relation to vision is one which merits the most careful consideration. Evidence that the advantages of high-intensity projection are being widely recognized is found in the rapidly increasing number of small and intermediate size theatres in which high-intensity projection is being used.

S.M.P.E. Discussion on New Aperture Proposal

(*Continued from page* 22)

anxious to make the maximum possible utilization of the space available on the film, which we will admit is none too large. We have talked for many years of going to wider film. The Academy is trying to make more effective use of the film. The main objection appears to be the cost.

Mr. Goldsmith: I must disagree on that point. It is not a fact that the major objection raised by the Projection Practice Committee is the cost, burdensome, inopportune, and unnecessary as that may be, and leading, as it might, to no result commensurate with the cost. That is *not* the only objection. The principal objection is that the dangers to correct projection, due to weave, shrinkage, and other factors, as pointed out in the report, are such that the Committee is fully persuaded that not only would the change be costly, but that it would be unsuccessful, resulting in the projection of frame lines and cutting off picture edges by screen masking beyond what now occurs. In other words, the Committee is persuaded that there is no present practicable way of expanding pictures within the dimensional film limits of today. We have already gone to the very limit of utilization; and, indeed, certain members of the Committee are doubtful whether (considering the effects of projection angles, film shrinkage, printer and projector weave, and all the rest of the inevitable things that occur in daily practice), we have not already gone too far in widening the aperture. They view with justified alarm any further increase.

The hair-line proposed by the Committee was intended as a convenient and cooperative measure for the cameraman. He could then compose his scenes beyond the hair-line if he so desired, but when he saw the essential action approaching the hair-line, he would know that it was time to be careful.

It is an excellent general principle to make railroad cars as wide as possible; and thus if there are 4 inches between opposing passing trains at present, we might like to widen each train 1.99 inches, and, as a result, have wider cars. The only trouble with that would be on a curve, or when the cars were swaying, passing each other at 80 miles an hour, the effect could only be disastrous.

The situation here is parallel. We are in a dangerous situation. The proposal not only makes a dangerous situation worse, but invites real disaster.

Mr. Jones: This seems suspiciously like standardization. Should we not handle this as we would standard, following our usual letter-ballot procedure? Of course, we may obtain an expression of sentiment here this morning, but I do not think we can take any official action. Should not the matter be referred to our Standards Committee?

Mr. Goldsmith: The resolution was simply that the report of the Projection Practice Committee be approved. The Committee's report does not suggest any new standards; it merely opposes the introduction of a proposed new standard. The Academy has released to the trade press, with wide publicity, a new proposed standard for consideration, which, in the Committee's opinion, is damaging and objectionable. All that is proposed here is that this standard be not approved and the Committee's original suggestion be approved, and that the Society uphold the Committee's viewpoint.

Mr. Edwards: I tried the proposed aperture in a first-run house. A Warner's first-run feature showed a black band at the right-hand edge of the screen, and a Fox newsreel showed the sound-track on the left-hand side.

Mr. Schlanger: The small gain of 5 per cent is inconsequential in comparison with what might be accomplished with a little care by the cinematographer to utilize the limits he now has. Using greater care in the cinematography will produce, not a physically larger scene, but an effectively larger scene; in other words, carefully studied action placement will produce action area on the screen that will be relatively much larger than the 5 per cent physical gain proposed.

Mr. Goldsmith: The question has been called for. All those in favor of approving the Report of the Projection Practice Committee as read will signify by saying "Aye." Contrary?

It is an unanimous vote.

Snook Named Head of RCA Photophone Sales

Homer B. Snook is now in charge of all Photophone's sound equipment sales to theatres and to industrial producer licensees. He has played an important part in shaping RCA Photophone's financial policies and is already widely known in the industry through his activities in charge of the credit and other financial phases of Photophone since 1932.

Motiograph Grants Shearer Exclusive Coast Franchise

Motiograph, Inc., has concluded negotiations with B. F. Shearer Co. for 100% sales representation on the West Coast. Shearer now has the exclusive distribution rights to Motiograph projectors and sound systems on the Coast through his branches in Seattle, Portland, San Francisco and Los Angeles.

News of the Month

Brief mention of men and events associated with the motion picture industry of particular interest to projectionists is published here.

ALTEC CORP., assignee of Erpi theatre sound system service contracts, has concluded a deal with the I. A. providing for the unionization of all its servicemen employees who work in theatres. The contract calls for $80 a week minimum and $110 maximum, the latter figure applying to those servicemen who work across jurisdictional lines. All Altec servicemen are required to join I. A. projectionist local union in their respective territories.

Signaturing of the Altec deal forecasts 100% unionization of all theatre servicemen shortly, irrespective of by whom employed, since anything less would be discriminatory against Altec.

Although all details are not yet settled, it is understood that Altec men will be admitted to various I. A. locals for a nominal initiation fee, with regular dues to apply thereafter; also, that these members cannot operate projection equipment. Other unsettled angles include the layout of jurisdictional lines in order to determine character of work and thus which scale applies; adjustment of the requirement of some local unions that all membership applicants hold a local projectionist license (which few Altec men do); the question as to whether the Altec men, as Union members, qualify as stand-by men, and the future of those sound service units organized by various local unions, notably in St. Louis, Cleveland and San Francisco.

RCA servicemen are understood to be next in line for organization, with various independent outfits in line for attention thereafter.

The I. A. special assessment of 2% against all working members, in force for nine months, was lifted as of Dec. 11.

Kann to 'Box Office'

Maurice ("Red") Kann assumes the editorship of *Box Office*, exhibitor trade mag. on Jan. 3. Kann, active in motion picture journalism for 20 years, resigned recently as editor of *Motion Picture Daily*, being succeeded by A-Mike Vogel.

Experts Compile New Academy Book on Sound Pictures

A new 525-page book entitled "Motion Picture Sound Engineering," representing more than six months of continuous effort by outstanding studio technicians is now on the press and will be published soon by the Academy of M. P. Arts & Sciences. Book covers thoroughly visual and sound production and reproduction, with advance notices hailing it as the most comprehensive summary of the art turned out thus far. Orders are now being accepted by the Academy, Taft Bldg., Hollywood, at $4 a copy, which price just covers costs.

Master Exchange Pact O.K.

Master contract governing working conditions, hours, wages and definition of terms in major company exchanges throughout the country was up for discussion recently, to supplant temporary pacts drafted last Spring. No startling changes skedded.

Germans See Non-Flam Film In General Use Shortly

General use of non-inflammable film stock for both commercial and amateur purposes in Germany is predicted for the near future, according to *Variety*. Contributing factor of development is that no cotton is needed for its manufacture, there being a shortage of raw materials in Germany.

Non-flam film has been in existence since about 1907. Its immunity to fire made the taking of motion pictures possible for amateurs. Law was passed in France 10 years ago that only safety film should be used, but it was never enforced because the film itself is not strong enough for commercial use, and its lack of flexibility makes it hard to handle in laboratories.

They have done a little experimenting in Germany. One hundred and forty-seven copies, parts or the whole of which were safety films, were sent to various theatres without mentioning the difference in material. Each picture was tagged to list observations, thus enabling a checkup afterwards. Results were that photographic effects and sound reproduction do not vary from the nitro.

Points in favor of the non-flam film are that it assures a greater amount of safety in studios, laboratories, factories and projection rooms, also in case of air raids; police restrictions would be considerably eased up. Faults are that the non-flam is expensive, weak on the sticking end and still too brittle. Year's experiments also show that the non-flam films have 85% of the durability of the nitros.

Death Takes 2 On Job

DEATH claimed two old-timers in the art recently under strikingly similar circumstances. W. Hoy, of Calgary, Canada, died suddenly on the job from an enlarged heart. He was a frequent contributor to these columns and a standout, progressive projectionist who was a credit to the craft.

Dick Mendam, of Easton, Pa., was also stricken on the job just as he removed a reel from the magazine and started toward the rewind. Here, too, a cardiac condition was the cause. Only three weeks before the fatal attack Mendam had a thorough physical examination and was informed that he was fit enough to pass any insurance test.

Fortunately, both men worked on a two-men shift and thus were not alone in their last moments.

N. Y. Lensers Slam Reels

Cameramen's Local 644 (N. Y.) is tiffing with newsreel producers about the use of material supplied by free-lance cameramen, which, states 644, is prohibited by the two-year union contract now in effect. The warning came from C. W. Downs, b. a.

Downs said that under the two-year union deal with the reels, producers are prohibited from purchasing films. He declared that the union recognized the fact that in the case of disasters and similar events, the use of free lance or bought material was necessary, but "now they are abusing the privilege." Two other practices to which the union objects is the use of newsreel photographers on commercial films and the exchanging of prints by the newsreel companies, which he contends results in the use of fewer cameramen, and which he called "unethical." The union may demand that its label be placed on the reels.

B. C. Boys Upset One-Man Shift Finding, Gain Pay

A brief strike enabled Vancouver, B. C., projectionists to not only invalidate the recent verdict of a special commissioner favoring one-man shifts but also won them a pay rise. Commissioner's report was published in and answered by I. P. An interesting development of the tussle was the disclosure that Famous Players Canadian Corp., who bore the brunt of the battle against Vancouver Local 348, has an authorized capitalization of 600,000 shares, of which 397,524 shares are issued and outstanding. More than 96% of the latter is owned by Paramount Publix Corp.

There seemed to be some difficulty previously in establishing this hookup.

Union Jottings

Edward Booth (how apropos) elected president of Washington, D. C., Local 224 (0) . . . . Joseph M. Steadman, pres., and Earl Hartman, b.a., in Youngstown, Ohio, Local 388 (0) election . . . . Local 15 election at Seattle, Wash., again named C. Crickmore, pres.; E. Clark, finance officer;

E. Booth, sec., and B. L. Grey, b.a. . . . . Out on Long Island, N. Y., Local 640 (0) named L. Schwartz, pres.; P. Jelis, v.p.; W. Nagengast, b.a., and W. Brose, sec. . . . .

Up in the Garden spot of the World (where else but in snooty Westchester County, N. Y.?) they had a re-election fiesta, with these results: Pres., Arthur Martens; B. J. Ritch, Irving Weiss and Anthony Dente as vice-presidents; Emil Smith, Sec.; Fred Thome, Fin. Sec.-Treas.; Richard Hayes, business mgr., and Albert Bell and George Alley, trustees.

Two interesting resolutions were adopted by the recent New England (3rd) District Convention: (1) registered opposition to pari-mutuel betting "because it hurts seriously the business from which we make our living"; and (2) requested theatre managers to postpone Xmas Day opening until 2 p.m.

Local 370A, Negro projectionist unit of the I. A., was organized in Richmond, Va., on Dec. 13. Oscar J. Holmes is the secretary.

BRITISH TELEVISION IN THEATRES SOON

Television on a 12 x 16 foot screen will be made available to British theatres within three months by Scophony, Ltd., of London, according to advices from that city. Among the advantages claimed for the Scophony system is that it can be projected on any standard screen; whereas with the cathode tube principle this is impossible at present. Scophony home sets selling for from $50 to $75 will be marketed shortly, it is reported.

British television, designed for comparatively short ranges and aiming at not too high quality, has led the world technical procession to date; but it is believed that the American television, once set, will demonstrate its superiority.

TELEVISION PROBLEMS: A DESCRIPTION FOR LAYMEN

(*Continued from page* 15)

ture must be transmitted in the same length of time, and this is more difficult. It has been a most important problem to determine the best number of lines to use, and in general to find the best compromise between the opposing factors of picture quality and apparatus difficulty. The value of 441 has been chosen after very careful study and experiment covering several years' time, and will be the standard value in this country.

Electron Beam Sweep

The little electron "searchlight" beam, sweeping across the plate with its 441 regular brush strokes, acts just as a wire brush would, and collects electricity from the cells on the plate as it passes over them. It is interesting and important to notice at this point that the scene being televised is focussed on the plate continuously, and therefore the cells receiving light are storing up electric charges continuously. The electron beam sweeping across the plate contacts with only one little spot of the plate at a time, which incidentally is smaller than a pinhead. After the beam has completed its travel all over the plate—that is, after it has traversed all the 441 lines—it comes again to the same spot on the plate. Each time it comes to a spot, it collects the electricity which has been storing up there while the beam was travelling over the rest of the plate collecting from all the other spots.

So the electron beam is a collector, travelling over the plate in a regular pattern of lines, picking up electricity wherever there is any present, as there will be in places where light is present.

Origin of Electron Beam

Now, this electron beam originates in a simple part of the "Iconoscope," which is called the electric gun or cathode. The cathode is covered with certain chemical compounds which give off electrons when heated, and the cathode may be heated readily by current, just as is a lamp filament. Therefore, the cathode is a part of the electron beam, and if we connect the cathode and the plate to external apparatus, we can obtain the electricity which the beam collects from the plate having the light image upon it.

The electric currents which are obtained from the image plate by the elec-

tron beam are of course very small. But they can be fed into vacuum tube amplifiers and be amplified to useful proportions. When this is done, we will have currents carrying intelligence representing the light pictures, and these we will use to control the transmitter antenna current.

Now, let us examine this scanning process again with an overall viewpoint. The scene to be televised is focussed upon the "Iconoscope" plate. The plate is continuously being explored by an electron beam, about the size of a pin, which sweeps across it in regular lines, taking 441 lines to cover the picture from top to bottom. The time required to sweep the whole picture is made such that the process can be repeated thirty times per second. In other words, every spot of the picture is visited by the collecting beam, thirty times per second, and there are about a quarter of a million spots on the picture to be thus visited! Undoubtedly the busiest thing in the world is this electron beam as it scans the picture, flying back and forth at a speed of several miles per second, and collecting the current, so to speak, at each tiny spot of its path.

In short, we have a system which is operating to pick up scenes a spot at a time, but covering spots so quickly and the whole scene over and over so many times a second, that if we arrange a reproducing system to act in reverse fashion to that described, and to deliver light images corresponding to the spot currents, our very slow human senses will not follow the details of the process, and will perceive only the average total result—which is the complete picture.

Other Engineering Problems

We have now "scanned" the process of television transmission, perhaps almost as rapidly as the "Iconoscope" scans a picture, and of course we have lightly passed over many engineering problems. It will be of interest to list at least some of them.

First the "Iconoscope" must have sufficient sensitivity, that is, it must be able to generate electric currents from small light intensites falling upon them. The latest forms have developed sensitivity to equal that of the photographic camera and film, so that any scene which can be photographed by snapshot can be televised.

Also, the "Iconoscope" must be free from color-blindneess. Present "Iconoscopes" are sensitive to all colors, and in fact to the invisible parts of the light spectrum as well as the visible. As a result, interesting applications are possible for purposes other than television,

and utilizing ultra-violet and infra-red rays.

We have referred repeatedly to movements of the electron beam over the image plate. Of course, its travel sideways and up and down is not inherent or voluntary, and must be caused and controlled. To do this, coils are located outside the tube, and magnetic fields from these coils move the beam as desired because the beam responds to magnetic forces. The nature of the currents in the coils and the physical location of the coils determine how the beam will move. The proper kinds of currents are provided from oscillating vacuum tubes and so-called deflection circuits. These currents, which are at the transmitter, will also be used to control a similar beam at the receiver, as we shall see later.

An interesting problem in the "Iconoscope" is one that may be described crudely as cleaning away the electrons in the electron beam after they have been used. The electron beam is playing upon the plate like a fire-hose, and some of the electrons are splashing off into the space in front of the plate, where they may gather in clouds. They must be cleared away for each fresh scanning of the plate, or the picture will be clouded or blurred.

Tremendously High Frequencies

The electric currents mentioned so frequently are alternating currents, flowing back and forth millions of times per second. Many of the most difficult problems of television result from the fact that such rapid reversals, or such high frequency currents, have to be used. Ordinarily we think of electricity as being instantaneous. Actually it is not, but has a finite speed of about 186,000 miles per second. So that when we call upon a current to travel even a few feet only, but to turn around and reverse itself, and repeat this millions of times per second, we begin to encounter limitations even in the speed of electricity. This situation is so real that a copper rod four or five feet long, which is a practically perfect conductor for current at low frequencies, under some conditions acts like an insulator when the current is at frequencies of millions per second. Since we have to make and connect up our television apparatus with wires hundreds of feet long, it is obvious that expedients and special conditions must be provided to enable the currents to behave as we want them to.

These tremendously high frequencies are forced upon us because we are trying to crowd so much information into each interval of time, much more than we need to with sound broadcasting, or telegraphy, or even facsimile.

The unusually high frequencies give rise to new problems in the really wireless part of the system, that is, the medium between the transmitting and receiving stations. Everyone is familiar with the conditions existing in sound broadcasting and knows that the quality of service received depends upon the power of the transmitter, the distance between transmitter and receiver, and the degree of static or other interfering noise present in the receiving neighborhood.

With the higher frequencies used for television, the same factors are present, but in different ways and degrees. The television frequencies are so high that the waves approach in behavior that of light waves. It will be remembered, of course, that there is no difference in character between light waves, heat waves, ultra-violet rays, X-rays, radio waves, except that of frequency. All are disturbances in space of the same character, and differ only in frequency. We are accustomed to ordinary radio waves going around the curvature of the earth, over and behind mountains, through buildings and so on.

But radio waves at television frequencies, behaving more like light, act somewhat as does a powerful searchlight. They do not follow the earth's curvature very well, or go behind a mountain, or through a building. Therefore they are more limited by obstacles on the earth's surface, and conversely, the transmission will be more effective, the higher the antennas are located. It is for this reason that RCA has located its New York experimental transmitting antenna atop the Empire State Building. Similarly, better reception is had by locating the receiving antenna as high as possible; and when television does come to the home, it will be found advantageous in most cases, to put a good antenna on the roof, rather

than a wire on the base board in the living room.

Very fortunately, there is little natural static on television frequencies. Unfortunately, there is considerable disturbance from certain man-made devices, especially automobiles (from their ignition system) and certain electro-medical devices. This can be eliminated readily, however, and no doubt will be eliminated when necessary.

The propagation characteristics of the medium and the interferences existent, chiefly determine the distances over which reception may be effected. The tests now being carried on by RCA indicate that with an antenna as high as the Empire State Building, satisfactory reception can be had to distances somewhere between 25 and 50 miles. Of course, there will be some locations at less than 25 miles, having especially bad conditions, where reception may not be good, and there may be a few high locations more than 50 miles away which will be able to receive. But, in general, it may be observed that the service area of a television station is limited, in comparison with the areas of sound broadcasting stations as we now have them.

This condition results in a television engineering problem of the greatest magnitude, and one with profound economic influence on the television problem as a whole. The service area of a station is small because the frequencies required for television are extremely high. Just as it is difficult to make these high frequencies travel far through space, so is it difficult to make them travel far over wires. Consequently the television studio must be located close to the television transmitter and antenna. This means that we cannot utilize the simple effective method used in sound broadcasting of conducting a single studio performance in one city, and radiating its program from scores of radio stations scattered over the country, all connected to the studio by wire telephone circuits. At present, a television program is confined to the area around the originating studio, and its audience can be only within that area.

Obviously, the expense of providing programs to the nation is vastly greater. In sound broadcasting, one performance on a nation-wide network of stations, reaches the whole country. To cover the country with a television program, with present technique, would require repetition of the program a thousand times, from a thousand studios.

Of course, a great deal of work has been done on this vital problem, and good reason exists for hopes of speedy solution. Wires of special kind which will be capable of carrying the high television frequencies are being developed. Radio circuits to carry them long distances by means of short distance relays are also being developed. Undoubtedly one method or the other, or both, will eventually be perfected so that a performance in one city can be transmitted to other cities, just as sound is now.

While on the subject of program expense, there is another aspect which is sometimes overlooked, in the comparison of television and sound broadcasting. In the latter, sound is all-important, and nothing else has to be considered. In television, not only is sound required, but the added visual problem corresponds to that of making a sound motion pic-

ture. Scenery, special lighting, and costumes are required, actors must be letter perfect in their parts—and retakes are not possible. This means that the more economical types of program will be those where artificial aids are minimized—for example, the football game, or news events generally.

(TO BE CONTINUED)

NEW SERVICE TOOLS NEEDED FOR VISUAL EQUIPMENT

(*Continued from page* 8)

much better than the double film. Why can we not have a gauge for this? Since many of us take the path of least resistance, the chances are that the roller adjustments will be more nearly correctly if it is easy to do. There is also the psychological effect which good tools and equipment have on the projectionist.

No one questions the importance of the fire shutter and the *proper* operation thereof. Improper opening of the shutter does not constitute a fire hazard, and such operation is readily evident. Improper closing of the shutter is dangerous, and is not so evident. The channels in which the shutter slides sometimes

become gummy from oil and dirt, thus hindering the free movement of the shutter. This may endure for some time without being noticed. How about a contrivance that would immediately indicate improper closing of the shutter? You would say that these channels should not be oiled and that they should be kept clean, and a close watch be kept on the action of the shutter. You would be absolutely correct; but the same thing is true of one thousand other details incident to running the show. The projectionist hasn't time to watch them all as carefully as he should. Possibly this should not be thought of as another service tool but rather as an addition to the mechanism, as with the magazine rollers mentioned above.

While we have meters to show the generator and arc voltage, and also the current, they are permanently on the switchboard; they cannot be removed to use in chasing trouble. Even if they were portable, they are not the type to use for miscellaneous testing. We have test lamps, and sometimes a buzzer test set, but these will not do all the necessary testing. As a rapid test for power failure, *etc.*, probably nothing can equal the test lamps, but they cannot be used to show a three-volt drop across a connection, say, at a switch or fuse block. Here is where a regular test set, similar to those used by the sound engineers, comes in handy.

Meters and Test Sets

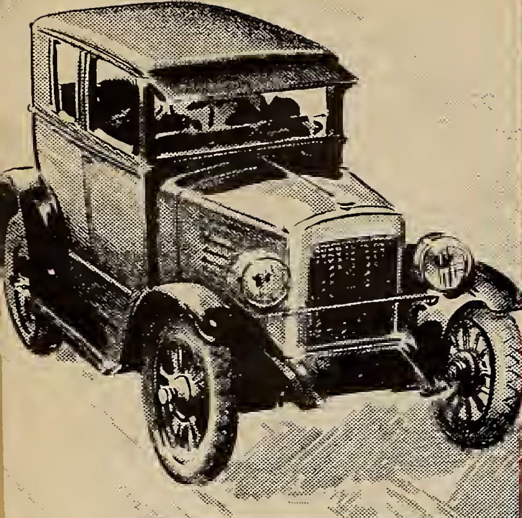
When a test set is mentioned, we usually think of using it on the sound system, but there are many other uses which justify the purchase of such a unit. Many will argue that the projectionist cannot use it. I don't subscribe to this notion. Many projectionists will run their service man a close second when working on amplifiers. On the other hand, such knowledge is not needed to do ordinary testing with this set. Seventy-five per cent of the men would be able to use it after about twenty minutes instruction. Do not get the wrong impression; I do not mean that twenty minutes instruction will prepare the average projectionist to shoot trouble in the sound system, but I do say that he can learn enough about the test set to do ordinary testing on the other equipment, such as lamps, resistance grids, generators, *etc.*

Looking back, we see little room equipment now that we did not have twenty years ago. Most of what we have is not service equipment; it is apparatus to assist in running the show. Two almost universal items, at least on the West Coast, are the electric dowser and the cue-meter. The cue-meter is a clock-like device that tells the film footage remaining on the reel. It is driven from the shutter shaft and runs backward, that is, it is set to the footage of the full reel, and as it runs backward it constantly shows the remaining footage.

Almost every room has carbon savers, and many have film splicers and measuring machines, but these are not for servicing. After all these years, we are hard pressed to name such a device. The only ones that really come under the classification are the meters on the board and the meter test set.

The Academy test reel is the one truly new thing available to be used for service work; but how many are in use?[1] It was designed especially as a service "tool" and really would help the projectionist. The writer has not seen one and knows of no one who has used it. Possibly the theatre owners have not been properly sold on the idea, or maybe they think that the projectionist should do just as well without it. This may also be their attitude toward other ideas mentioned in this article. It does not seem possible that projection will continue indefinitely as it has in the past. Other crafts and industries have been moving ahead, and some day this projection business may snap out of it. Possibly it will be some projectionist who hits upon one or more good ideas and will cash in on it. More than likely, though, it will be an enterprising manufacturer. Projectionists should band together and agitate for the development, the purchase and the use of new servicing tools.

[[1]An important omission here is the S.M.P.E. Test Reel for sound and visual projection equipment. Projectionists might submit a list of other omissions anent service aids developed recently, such as the oscilloscope, etc.—EDITOR.]

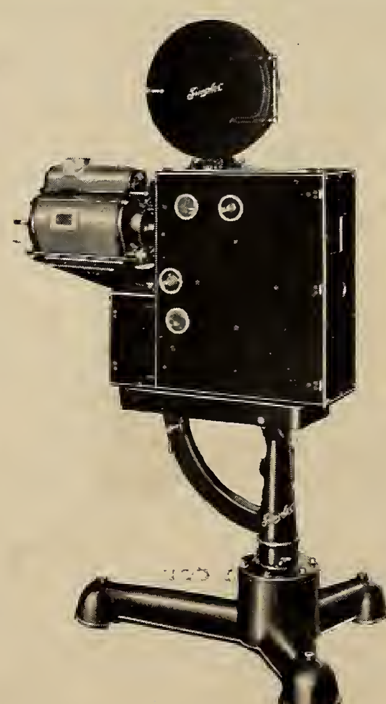


Would you choose The OLD or The NEW?

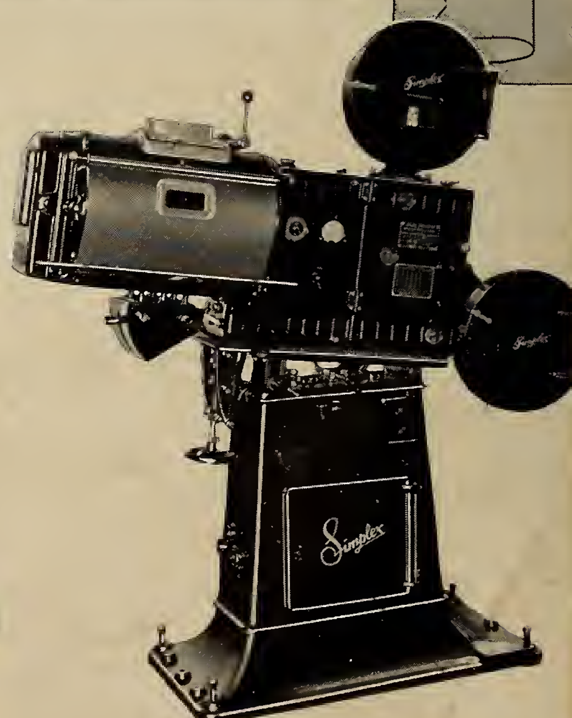
WHY BUY SECOND-HAND EQUIPMENT WHEN YOU CAN GET BRAND NEW *Simplex* PROJECTORS AT A PRICE YOU CAN AFFORD?

TRADE MARK REG'D

SUPER SIMPLEX PROJECTOR
Standard Throughout the World



SIMPLEX SOUND PROJECTOR
Type SP—For Smaller Theatres



SIMPLEX SOUND PROJECTOR
Type SA—Standard Complete Sound Projector

Manufactured by INTERNATIONAL PROJECTOR CORP., 88-96 Gold Street, New York, N. Y.

DISTRIBUTED BY NATIONAL THEATRE SUPPLY COMPANY